PUBLIC LIBRARY OF THE

AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL 11, No. 52. WEEKLY. | NEW YORK, DECEMBER 27, 1888. | $2.50 per Annum. SINGLE COPIES 5 CENTS.

COPYRIGHT 1888, BY AMERICAN MACHINIST PUBLISHING COMPANY. For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

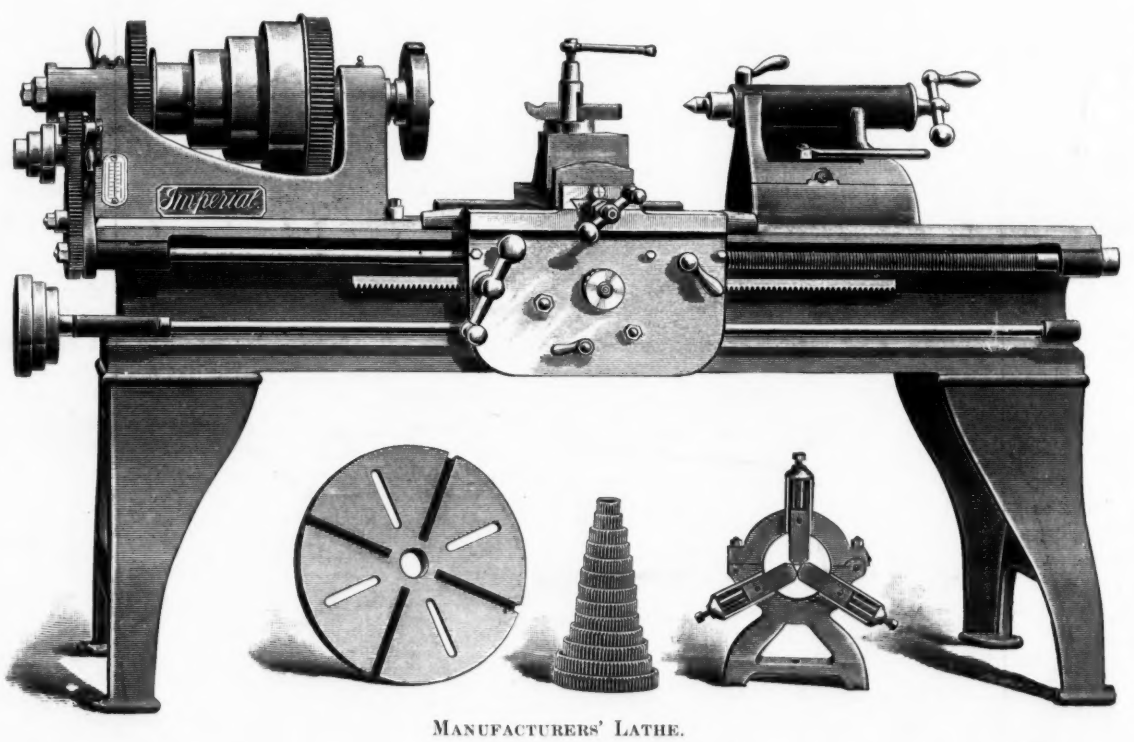
Seventeen-Inch Manufacturers' Lathe.

The engraving represents a style of lathe recently brought out by Lodge, Davis & Co., of Cincinnati, Ohio, which has been especially designed for the use of manufacturers, and, possessing points of essential difference from their regular line of lathes, has been designated as the "Imperial," to distinguish it from them.

In these lathes the compound rest, taper attachment, automatic stop, etc., have been dispensed with, and the position of the lead-screw changed, it being outside the bed instead of inside. The rack has been put below the screw, in order to get the latter as high as possible, and allow the half nuts to be attached to the saddle instead of to the apron, as is usual. This, with the other features of construction, dispenses with all bolts between the gears and the tool when chasing threads. There is an automatic feed, the rest having a bearing of 18″ on the cross-slide.

Solid boxes are used for the spindle, bored taper, and with provision for taking up wear by drawing the spindle back, the usual difficulty experienced in taking machinery apart, when constructed in this way, being overcome by a special provision for removing the key of the large gear wheel through the hub.

This construction is thought to be best for the service for which this lathe is designed, as it prevents tinkering with the boxes, keeps the spindle in line better, and is more solid. The screw-cutting arrangement (which cuts from 4 to 20 threads per inch), is driven from the end of the spindle, and the studs in the reverse plate are solid with the plate. The half nuts are operated by a cam, which locks itself in either position.



MANUFACTURERS' LATHE.

The tool post has a bearing in a square shoe, which fits the T-slot, and is bored out to let the post through, thus securing a bearing all around the post. The front bearing tapers one inch in its length, and is 2⅜″ diameter. The back gear is proportioned 10½ to 1, the large gear being 11⅛″ diameter, with 1⅛″ face. The pulley has four steps for a 2½″ belt.

The lathes are made with 6, 8, 10 and 12 foot beds, and the same style lathe is made of 21, 24 and 30 inch swing. Countershaft is furnished, which, for the 17″ lathe, has 12″ tight and loose pulleys, and should run 130 revolutions.

The dynamite gun cruiser "Vesuvius," built for the Government at Cramp's yards, Philadelphia, made 21.47 knots per hour over a measured course in Delaware Bay. The contract called for a speed of 20 knots. It is fairly evident that, when her machinery gets worked down to a good running condition, she will be, as Commodore Walker expresses it, "a daisy to go."

It is said that more work has been done in Boston shipyards during the past year than for several years past.

Practical Engine Testing.

By W. H. Booth.

FIRST PAPER.

A full and minute test of a steam engine, involving full particulars of temperature of feed water, hot well, flues, chimney, etc., is a work requiring the services of many observers, when conducted with a view to obtain what may be termed scientifically accurate results. Tests thus conducted are often considered necessary to determine whether an engine will fulfill certain contract requirements. In such cases a double set of observers is stationed at every point, as a check upon the accuracy of the results, as well as for the purpose of preventing fraudulent misrepresentation on behalf of either party to the test. Even in the best-conducted tests there is frequently some point overlooked, which destroys the value of the results obtained, from a scientific point of view.

The reports of such tests are sufficient to deter many from even attempting to carry out a test of their own steam plant. Such, however, ought not to be the case, and when a test is made simply for the purpose of ascertaining with reasonable accuracy the efficiency of an engine, or boiler, or both, and by persons whose desire is to find out facts, not to falsify results, then a test is by no means a formidable affair, and may be undertaken by one skilled man, if honestly assisted by the ordinary staff of the establishment. An accurate test requires a careful weighing of the coal consumed, and, so long as the engineer is satisfied as to the capacity of his assistant to keep a check on the coal shot onto the firing floor, and of the ability of the man who weighs the coal to weigh correctly, he need exercise no further trouble on that score.

Assuming, then, reasonable care and an honesty of purpose, any man in charge of steam power may make a test of his machinery, and know where it is at fault, and its efficiency. The following plan of test may well be adopted in these circumstances. The first requirements are, of course, accurate instruments, as follows, and we will assume that only one of each is available: A steam engine indicator with springs for both the high and low-pressure cylinder; an accurate thermometer; a vacuum gauge on the condenser and a pressure gauge on the boiler. The two latter require to be checked by the indicator, and their difference noted. This is best done by taking a card with the indicator from both the condenser and the boiler, which remains as a record, and upon which the reading of the gauges must be set down. All readings of the gauges during the test are to be corrected to the datum of the indicator. It is convenient, and conducive to speed and accuracy, to have more than one thermometer, which may be compared with each other both before and after the test. If so, one should be placed in the feed supply to the boiler, and a second in the injection supply to the condenser, and a third in the hot well or ejection. When only one thermometer is available, it is necessary to spend more time at each reading of it, and care is required, that the reading be not taken before the mercury has risen or fallen to the proper point.

In taking diagrams from the engine, the instrument is best attached first to the low-pressure cylinder, and, though it is best to use the shortest possible connections, it is a great aid to the observer, to be able to take a figure from each end of the cylinder at one fixing of the instrument, by means of the pipe with three-way cock, which must first be ascertained to be in order, and steam tight. The indicator is then to be changed to the high-pressure spring and moved to the small cylinder, and the diagrams taken, after which the boiler pressure must be noted down and the temperatures of feed, injection and hot well read off. All this may comfortably be done in fifteen minutes, and various other points noted, such as the water level in boiler, the amount of feed supplied or coal weighed against boiler. At the expiry of fifteen minutes, another set of diagrams is taken from the high-pressure cylinder, the instrument moved to the large cylinder, and cards taken, and the various pressures and temperatures read off as before. This is repeated throughout the working day.

Everything in a test depends on the commencement and finish. A fair test should embrace a balance of these two. Many tests have been made, and showed wonderful results, simply because the fires have been piled with coal at the start, and burnt down at the finish—a manifestly unfair proceeding. It is a good plan to start a test with a newly cleaned fire, so that there is a thin layer of incandescent fuel on the grates. All coal then used must be weighed against the test. Exactly at this time, when the steam pressure should be very near the working amount, a thread should be tied round the water gauge glass at the water level, and its position measured also in case of its slipping down. Having thus started in good working order, with no ashes in fire or ash-pit, all coal used must have been weighed against the test, and, as closing time approaches, the water level must be brought gradually up to the starting level, the steam pressure also being maintained, and the fires so managed as to be just left in a cleaned-out condition, thin and red at the close of the test.

If these points are attended to, no corrections are needed in the calculation for difference of water level in the boiler, difference of heat stored in the boiler, or for fuel weighed and not consumed; for the boiler is left just as found, and the coal thrown into the furnaces is the exact amount used; the ashes removed, including final cleaning, are the products from the fuel used, and the water consumed by the engine is exactly that fed to the boiler, the blow-out tap of which should not be used during the test.

The amount of water used is sometimes determined by a meter. This ought to be tested by passing through it a known volume of water. It is better to actually weigh the water in a barrel or tank placed on a platform weighing machine, running each weighed quantity into the supply tank of the pump or injector, the overflow of which latter must not be run to waste, but returned to the supply well.

When it is not convenient to weigh the water, there is sometimes a large cistern, which will contain more than enough for the whole period of the test. In such case, the area of the cistern should be carefully ascertained, and the amount of water drawn out during the test is to be measured by the multiple of the area and difference of level. The latter may be measured by a sounding rod, carefully erected before and after test at a certain spot in the cistern, the wetted limit being exactly marked upon the rod. For water thus measured by volume, a correction for temperature is required, a cubic foot at 46 degrees weighing 62.418 pounds, and

the co-efficient of expansion per degree being .00006. Thus a foot of water at 65° weighs only 62.344 pounds.

For any ordinary test, to determine the coal and water consumption of an engine and boiler, no further precautions need be taken. Such a test determines, of course, merely the running consumption, any greater total consumption being caused by loss at night from radiation, which has to be made up in the morning by a certain weight of coal being burnt before the engine is started.

In conducting a test, we have supposed that steam is kept fully up until stopping time. This is necessary for obtaining a proper running record. In practice, to secure as near an approach as possible to the running or test consumption, the fires are allowed to burn down towards the close of the day, and a later cut-off on the engine utilizes the reduced steam pressure. If not possible to obtain the weight of water used, a test will merely tell us the consumption of fuel per horse-power, for which the same precautions as to water level, blowing off, etc., must be taken to ensure accuracy in the results. Such a test, however, is of little service, unless the coal consumption is small. Thus, if as low as 1¼ pounds per horse-power per hour, we know that both engine and boiler are in high class condition, but if a result is obtained of four pounds of fuel, we cannot know from this anything, except that the net efficiency of the steam plant as a whole is poor. We cannot know whether the fault is with the engine or the boiler, or with both, for whilst we may have a very economical engine, the boiler may be wasteful.

Every engineer in charge of steam power should endeavor to secure an occasional test. The conditions may be varied every time. Thus the waste by blowing off would indicate the propriety or otherwise of taking means to render blowing off unnecessary. A day's test without steam in the jacket would show the value of this appliance. A variation in the cut-off of the low-pressure cylinder would assist in finding the most economical point of cut-off. Information thus gained and communicated to the technical press would be invaluable as an addition to our knowledge of the steam engine, and there are many places, such as textile factories, where a very uniform power is developed the day through, that are well set out for such a test. This is specially the case where the day's water supply can be taken from a cistern, as the only extra labor is the weighing of the coal. Where the rate of work is very variable, the power developed can only be coarsely approximated by even frequent indication, and, unless a power meter is at hand, the result is very uncertain.

When the consumption of water by the engine comes out specially low, as say 16 pounds, doubts may be thrown on the accuracy of the water measurement. Should the evaporation be specially little per pound of coal, there is a possibility that an error may have been made. If, however, the boiler appears to have evaporated say nine pounds or more of water per pound of fuel, it is evident that, unless a mistake has also been made in the coal weighing, the water consumption of 16 pounds per horse-power is probably correct. One result serves as an approximate check on others, for in such a case as quoted, if the engine has used more than 16 pounds of water, the duty of the boiler must have been so much higher. This would perhaps be unlikely with the quality of fuel used.

Extended tests of steam engines comprise a measurement of the amount of condensation water. This is measured by the tumbling notch, and is claimed as accurate, the head above the notch being frequently noted. Such a method does not appear calculated to give anything like scientifically accurate results, which are best obtained by the use of tanks alternately filled and emptied. It would be difficult for a single observer to conduct such a test as this unaided, unless very exceptionally situated as regards appliances, but for ordinary tests, to which no person of dishonest intentions can have access, the conduct of a day's experiment is by no means the formidable undertaking it is usually considered to be, and, besides the indicating, involves only careful readings of thermometers and gauges.

Before a test is undertaken, as well as after, it is well that the error of every pressure or vacuum gauge be known. During the test, however, no attempt should be made to record true readings. The actual erroneous reading of the gauge should be noted, and all necessary corrections made afterwards at the desk.

The writer had once to undertake a test where a great variety of instruments were in use. His own indicator and thermometer were in British measures. The steam pressure gauges were graduated to kilogrammes per square centimeter, and coal was weighed off in kilogrammes, whilst water was measured in a large tank, where a differeuce of level in centimeters was rendered in cubic meters of water.

The vacuum gauge was graduated to some premetric French measure, being an old instrument.

All the readings were afterwards reduced to one standard, but, had any attempt been made to do this during the test, errors would surely have crept in.

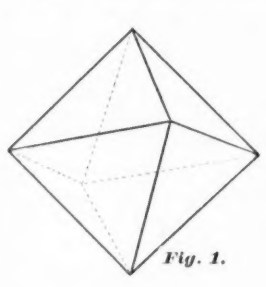


Fig. 1.

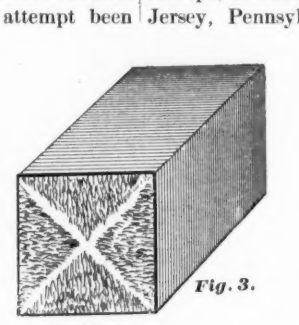


Fig. 3.

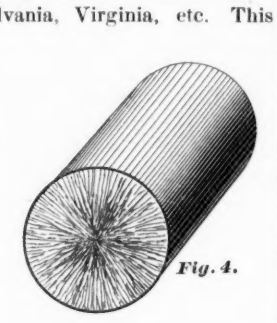


Fig. 4.

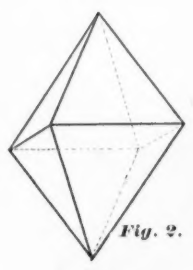


Fig. 2.

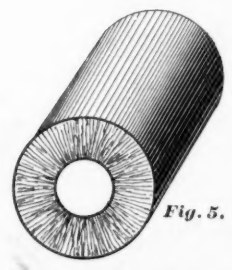


Fig. 5.

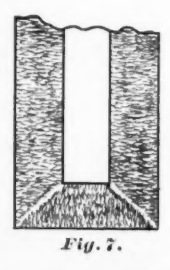


Fig. 7.

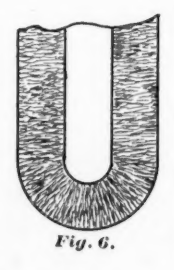


Fig. 6.

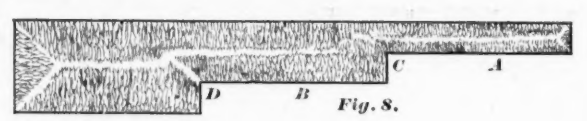


Fig. 8.

Fig. 9.

Fig. 11.

Fig. 10.

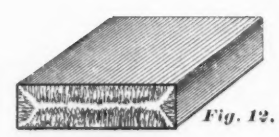


Fig. 12.

Crystallization and Shrinkage of Cast-Iron.

BY S. BOLLAND.

Before entering on the subject proper of this article, it is important that we consider for a while the nature and properties of cast-iron. Such a course will, I think, help to clear away much of the apparent mystery which seems to cling to the subjects of crystallization, contraction, shrinkage and warping of castings.

There is no valid reason for supposing that much, if not all the trouble and anxiety which the founder experiences on account of warped and broken castings, cannot be obviated, and the whole matter brought under absolute control. But the moulder will never control this very important branch of his business until he steps out of the beaten tracks made for him by his predecessors in the trade, and determines to acquire the knowledge that will enable him not only to mould from the pattern given him, but also to detect the faults in its design, and take such precautions as will insure success in the end.

Again, no one believes that the moulder who is ignorant of the nature and properties of cast-iron can be thorough at his business, nor need ever such a one aspire to anything more than being a mere machine at his trade. Hundreds of moulders are absolutely ignorant of the modes of producing cast or pig-iron, and therefore it cannot be expected that such will be able to meet the numerous emergencies which, from time to time, beset them. It is for their benefit, principally, that we take a brief survey of its manufacture.

The ores from which iron is smelted are found all over the globe, the chief kinds being: 1. Carbonate of iron, including spathic ore, which is found in thin plates or scales; clay ironstone, and blackband ironstone. 2. Magnetic iron ore. 3. Red hematite, specular or red iron ore. 4. Brown hematite, or brown iron ore. The magnetic ore gives the richest yield of metal, about 73 per cent. when pure. It is found all over Europe, in Canada, and in the States of New Jersey, Pennsylvania, Virginia, etc. This ore is usually smelted with wood charcoal, this being the cause of its superiority; there being no sulphur in the fuel. Red hematite ore is also very rich in iron, giving about 70 per cent. by weight. This ore is found in the Isle of Elba and other parts of Europe, especially Whitehaven and Ulverstone, England. Brown iron ore is a very important ore in England. and is much sought after by Germany and France. Carbonate of iron is known as spathic when it is found comparatively pure and crystalline, and as clay iron-stone and blackband when earthy and impure. The spathic ore is found in great quantities in Prussia and Austria, and is in great demand to yield the spiegeleisen required in the Bessemer process of making steel. To give some idea of the large percentage of impurities contained in some of the ores, I append an analysis of the clay ironstone, Blackbed mine, Yorkshire, England.

Protoxide of iron	36.14.
Peroxide of iron	0.61.
Protoxide of manganese	1.38.
Alumina	0.52.
Lime	2.70.
Magnesia	2.05.
Carbonic acid	26.57.
Phosphoric acid	0.34.
Sulphuric acid	trace.
Bisulphide of iron	0.10.
Water, hygroscopic	0.61.
" combined	1.16.
Organic matter	2.40.
Insoluble residue, chiefly silica and alumina	25.27.
	99.85.
Metallic iron, per cent	29.12.

This extraordinary amount of impurities in the ores necessitates considerable preparation prior to smelting in the blast furnace. One method is to break the ore into small pieces, and mix along with it small coal. The pile, which may contain a thousand tons or more, is lighted at the end and allowed to slowly burn or roast (as it is usual to term it) for about a month, or until the whole has undergone calcination. Special kilns or calcining furnaces are also used for this purpose, the waste gases of the blast furnaces being utilized as fuel. The process of calcination separates from 30 to 50 per cent. of these impurities from the ironstone, besides effecting certain changes in the chemical constituents of the ore, which greatly facilitates the process of smelting. Rich and comparatively pure ores are not subjected to calcination.

The proportions of materials necessary to smelt a ton of pig-iron will naturally vary according to the nature of the fuel and ore, but the figures given below are sufficiently near for illustration: 2 tons of calcined ironstone, 2½ tons of coal (about 800 lbs. of which is required for the hot-air pipes and blowing engine), and from 1,200 to 1,600 lbs. of limestone.

Blast furnaces for the production of pig-iron are necessarily of large diameter, and are built from 40 to 100 feet in height; the charges are fed at the top, consisting of alternate layers of the materials mentioned in such order as will best secure perfect combustion of the fuel, and steady melting. Where hot air is used for blast, it is heated to from 600° to 1,000° F., and enters the furnace through tuyeres arranged somewhat after the plan of a foundry cupola. When the furnace is successfully working, the clay of the ironstone unites freely with the limestone, and forms a slag or cinder, which is allowed to run off at suitable intervals; the oxide of iron at the same time gives up its oxygen to the fuel, and the metal falls to the bottom of the furnace. When sufficient metal has accumulated, it is tapped and run into moulds formed to receive it, such moulds being the form of the pigs as we see them in our foundries.

The metal produced contains from 3 to 5 per cent. of carbon, which it absorbs from the fuel, and it is this percentage of carbon which gives it the quality of cast or pig-iron, as distinguished from wrought-iron and steel. Owing to the great heat required to reduce the ores in the blast furnace, the iron is never obtained free from the elements remaining in the ores after calcination, such as silicon, sulphur, phosphorus, manganese, and in some cases arsenic, titanium, copper, chromium, etc., according to the ore used.

These impurities insinuate themselves into the cast-iron produced, in a greater or lesser proportion, according to the way the furnace is working, and a perusal of the analysis of Lake Superior pig-iron (charcoal), given below, will show to what extent this occurs.

Iron	93.34.
Combined carbon	0.38.
Graphite	3.39.
Silicon	2.28.
Sulphur	0.03.
Phosphorus	0.10.
Manganese	0.17.
	99.69.

The carbon in pig-iron is always found in the two forms, combined and graphitic, but varies in its proportions according to the variety of the iron; the greyest iron having almost all of its carbon in the uncombined or graphitic form, whilst the hard, white irons have it almost wholly combined; but the

amount never exceeds from 3 to 5 per cent. in whichever form it may exist.

The difference in color, strength, hardness, fusibility, etc., of cast-iron, depends upon the relative proportions of these two forms of carbon, varied by the influence of the above-mentioned elements, which are always present in some degree or other. We thus have grey, mottled and white iron, or, as they are commercially classified, No. 1, No. 2, No. 3, and forge iron. The No. 1 is the darkest grey, and contains the most graphitic carbon, as seen by the fracture, which is largely granular, and presents numerous graphitic planes or scales. When these abound, the iron will be found weak, with very little tenacity, and only suitable for light ornamental work, stove plate, and all thin castings requiring little or no finishing. This iron, when melted and in the ladle, lacks the brightness exhibited by some of the higher numbers, however high its temperature may be; and, should it be allowed to cool, it will be observed that a scum or kish rises to the surface, composed of graphitic carbon, evidencing the inability of the metal to hold as much carbon in solution whilst at a low temperature as it does at a greater heat. When kish appears on the surface of the metal, it is rendered unfit for use, as castings run with such iron present an unsightly appearance, being covered with a thick coat of plumbago.

No. 2 presents a more regular appearance in the fracture, the crystals are smaller, the color is a lighter grey; it is also harder and stronger than No. 1, and when in a molten state it does not exhibit the same tendency to kish as it cools. This iron is esteemed the most useful for general purposes.

No. 3 contains less carbon than No. 1 or No. 2, is less fluid when melted, but is much stronger, as it is more compact and dense; the crystals are still smaller and the color lighter than No. 2. This iron is suitable for heavy structural work.

The higher numbers up to white iron are designated forge irons, and are serviceable for puddling. Sometimes the pig will solidify partly as grey and partly as white, the crystallization having commenced in patches, but not spreading through the mass before it solidified. Such iron is called mottled pig, and it may be used in conjunction with other irons in heavy castings which call for great strength and closeness of grain.

Certain kinds of grey iron, rapidly chilled after fusion, become white or mottled; the amount of combined carbon increasing, whilst a corresponding decrease of graphite takes place. On the other hand, some kinds of white iron, slowly cooled after fusion, show a separation of graphite and a corresponding diminution of the quantity of combined carbon; and according to Ackerman (a great authority on these subjects), "long continued maintenance at a yellow heat is sufficient to change white iron into grey."

As cast-iron changes from the molten to the solid state it crystallizes, the form of the crystals being either octahedral, as seen in Fig. 1 (page 2), or rhomboidal, as in Fig. 2. These crystals always arrange themselves in the casting with their principal axes perpendicular to the surface through which the heat has passed during the process of solidification.

It is a noticeable fact that slow cooling produces the largest crystals; this should suggest to the founder the propriety of pouring large castings with metal at as low a temperature as will allow of a correct impression of the mould being taken. By following this rule the cystals will be smaller. on account of the more rapid solidification of the mass, and consequently additional strength will be imparted to the casting, by virtue of the greater compactness of the iron.

The appearance of the fractured surface of broken pig-iron is not always to be taken as a sure indication of its quality. It is pretty certain, however, that when the fracture shows a uniform dark grey, with strong metallic luster, it indicates toughness; whilst, again, dark, leaden-colored irons, lacking luster, with spots of mottle running through, will be weak and unserviceable. A light grey with strong luster indicates strength and tenacity, but a light grey without luster will invariably be found hard and brittle, and still more brittle as it approaches a greyish white.

The founder, most assuredly, has many kinds of iron to choose from, the strength and fluidity of which will be according to their composition and mode of production. Cold blast-iron from the same ores is stronger than if produced by hot blast. Iron which contains sulphur in small quantities is strengthened, whilst phosphorus has an opposite influence, decidedly weakening the iron, although it gives great fluidity when melted. Silicon, if present in iron, even in small quantities, weakens it; and if the proportion be large, makes it hard and brittle. Manganese, almost always present in pig-iron, tends to produce whiteness, as well as to make it more brittle. The strength of cast-iron is diminished by anealing.

When we consider the great change brought about in the nature of iron by the introduction of these elements, we discover the difficulties which beset the founder in meeting successfully all the demands made upon him for just the correct mixture for every casting he makes. When selecting iron for castings which have to resist impact, such as hammers for forges, etc., it is best to select from among the No. 3 irons such as show a close, tough texture; this conjunction with good scrap which shows a small crystal in the heavier fragments, will answer the purpose well, especially if the pig is chosen from different brands; for it must be remembered that better results accrue from a mixing of brands than when one brand alone is used; the mixed brands being stronger than the average of brands taken separately.

Steam cylinders and all castings demanding a clean, hard face when finished, must be made from very compact brands of grey iron, hardened by a plentiful admixture of scrap, such as mentioned above. For such castings always avoid using iron which shows a large percentage of graphitic carbon in the fracture with large crystals, as it is sure to give trouble on account of the heavy scum arising from it in the mould. When practicable it is best for this class of work to run the mixed iron into pigs, and remelt for the casting; this improves the tensile strength of the iron, and gives it greater density.

Although much depends upon the experience and judgment of the founder to obtain the required degree of fineness and strength, yet it must be conceded that the strength of a casting may suffer deterioration from faulty designing with respect to the arrangement of its several parts, considered with regard to the influence its shape will have on the metal when it passes from the liquid to the solid state.

As before stated, cast-iron assumes the crystalline form when solid, and it is an established fact that the crystals arrange themselves in a certain position in all castings, the tendency being with their principal axis perpendicular to the sides of the casting, or, in other words, they lay lengthwise and perpendicular to that part of the mould through which the heat passes; they are not always as regular and well defined as shown at Figs. 1 and 2, but they incline to that form, nevertheless.

By referring to Fig. 3, it will be seen how the crystals arrange themselves in solids of that class; the rays indicate their position in all solids of equal dimensions. The heat passing out at a uniform rate on every side gives four distinct systems of crystals, as it were, forming a junction at lines across the corners. This point of junction must of necessity be more or less imperfect; in fact, experience proves such to be the case; consequently the part where these several systems of crystals meet will be weak always. The weakest parts in this case are indicated by the diagonals; crystallization commencing first at the outside, and the process of solidification being uniform in every direction, must result in just such an arrangement of the crystals as is indicated by the figure.

What has been said with regard to crystals arranging themselves with their principal axis perpendicular to the sides, is verified by the solid shown at Fig. 4, a round shaft, the rays of which are seen to radiate from the center; nor does the insertion of a core, as in ordnance, in any sense interfere with their position. See Fig. 5.

It will be remembered it was said that rapid cooling produced the smallest crystals. Figs. 4 and 5 will serve to illustrate this part of the subject. All solids have their largest crystals in the center, gradually diminishing in size towards the circumference, caused by the almost immediate solidification of the outer parts; the inner mass taking longer to dissipate its heat through the gradually congealing metal.

It is this which causes cannon cast in the ordinary way to be spongy or porous in the bore, the only remedy for which is to bring about equal rates of cooling, by introducing a current of either cold air or water into the arbor or barrel upon which the core is made; by so doing unequal crystallization is obviated, and the metal made uniformly dense all through.

Cylinders for hydraulic purposes are made as shown at Fig. 6 in preference to Fig. 7, for the simple reason that the flat surface on the bottom of the core, with a corresponding flat surface on the bottom of the cylinder, as seen at Fig. 7, causes an arrangement of the crystals which produces lines of weakness from the outer edge of cylinder to the angle of core. This evil is prevented by adhering to the curved outline, as seen at Fig. 6.

SAFETY SET COLLARS.

Fig. 8 will serve to explain the evil effects of abrupt changes in the outlines of castings. The thinnest part *A* cools first, followed by the part *B*, the crystallization of which taking place after *A* is comparatively solid, forms a weak spot at *C;* because, as before stated the crystals pack themselves in the same direction as that which the heat takes in passing from the molten iron to the outer surface.

Obeying this law, they must detach themselves more or less at these points of junction. Of course the same result occurs at *D;* in fact, all castings whose outlines present these sudden changes of conformation must deteriorate in strength; for, whether we see the checks or not, it is certain they exist in a greater or lesser degree. The simple remedy in this case is shown at Fig. 9, which represents a solid of the same bulk, so changed in its outline that the planes of weakness are reduced to a minimum.

Figs. 10 and 11 will aid in arriving at a true estimate of the superiority of curved lines, to give the maximum amount of strength for a given area of section. They may be taken for sections of wheel arms with mid-feather, or as columns. At Fig. 10 the crystals are seen to arrange themselves perpendicularly to the sides and ends of the webs, giving weak lines at each of the inner angles.

How changed the scene when we look at Fig. 11; by simply rounding off the outer angles, and substituting a curve for the sharp angle at the junction of the webs, we obtain a continuous figure, presenting an unbroken outline, perpendicular to which the crystals arrange themselves with comparatively no interruption whatever.

In order to a clear elucidation of the laws of crystallization, and the consequent lines of weakness resulting therefrom, it will be necessary to examine into forms other than round and square. Fig. 12 is a rectangular solid, and shows an additional line of weakness, running parallel to the upper and lower surfaces, and connecting with the diagonals.

It would appear that this casting is veritably split in halves along this plane of weakness, and such is really the case in a partial sense. Examine the broken castings on the scrap pile, and innumerable examples will be found to prove this assertion; for in some pieces cavities are formed in exactly such places as are indicated by these lines of weakness, revealing the last stages of crystallization in all parts of the fracture; and where this phenomenon does not occur, a careful examination of the top surface of the casting will show that the upper section has fallen down during the process of solidification, and left a corresponding concavity there. It is here seen why we attach the riser or feeding head on all such castings; the idea being to maintain a communication with these central planes of weakness, and by a constant feeding of hot iron to this particular place, counteract, in some measure at least, the tendency to hollowness caused by the shrinkage of the mass during the process of solidification.

Further examples and illustrations will be given in a succeeding paper on this subject.

A Safety Set Collar.

The accompanying cuts show a collar designed to take the place of the ordinary solid collar used on shafting and about machinery.

The upper cuts show it as made solid, and having the set screw sunk into a cup, which prevents its being knocked off, or catching belts or clothing.

The lower cuts show it as made in two parts, for putting over a shaft where it cannot well be put over the ends. There are no screws to hold the parts together, the arrangement being such that tightening up the set screw draws the parts together and holds them firmly to their places. This allows of their being put on, in place of the ordinary set collar, with its dangerous set screw, without disturbing the shaft, it being only necessary to break off the old collar and replace it by one of these.

They are made in all sizes to standard gauges, by Chas. W. Shartle, Middletown, Ohio, who, by the saving of metal effected by coring and the use of special machinery, claims to furnish them cheaper than the ordinary solid collars can be made in the usual manner.

Occupations for Convicts.

A sensible suggestion is made by Mr. C. E. Chittenden, of Scranton Pa., in a letter to the *New York Tribune*, on this subject. He proposes that convicts should be set to work at winding silk; that is to say, the unwinding of cocoons, which is the first process in silk manufacturing. At this work, which is now wholly done abroad by cheap labor, he thinks they could earn thirty to fifty cents a day, thus keeping them from idleness, benefiting the silk industries of the country, and competing with no one.

Mr. Chittenden's suggestion might be carried much farther in the direction of employment in the work of producing other goods that are not produced in this country. The manufacture of tin plate is a field in which prison labor might be advantageously employed, without entering into competition with a single American laborer.

John Wiley & Sons have in preparation a "Manual of the Steam Engine," by Prof. R. H. Thurston. It is intended as a companion volume of the "Manual of the Steam Boiler," by the same author.

Practical Drawing.

BY J. G. A. MEYER.

SIXTY-SIXTH PAPER.

517. Fig. 410 (last paper) represents one-half of the development of the cylindrical surface *a b c d* (Fig. 408). Now, it must be readily perceived that, to find this development, we have only to follow the instructions given in Problem 74, and illustrated in Figs. 378, 380. Indeed, the problem before us and Problem 74 are identical, and therefore further instructions for finding this development are unnecessary.

But by a little reflection it will be seen that, in practice, we may save labor in finding the development shown in Fig. 410. The line *k l* in Fig. 409 is equal to the line a_5 b_5 in Fig. 410, because both figures represent one-half of the development of cylindrical surfaces, whose bases are equal to each other; and since the lines *k l* and a_5 b_5 are simply the developments of one-half of these bases, they must be equal to each other. Again, under the conditions given in the present problem, the angle *b d c* is equal to the angle *d f e*, or, to make this plainer, we may say that, when the cylinder *c d e f* is laid upon the cylinder *a b c d* with the elements *c e*, *d f*, of the former coinciding with the elements *a c*, *b d* of the latter, the line *e f* will coincide with the line *c d*. Here, then, we have a cylinder *a b c d* intersected by a plane *e d*, which makes an angle with the axis of this cylinder equal to the angle formed by the plane *e f* with the axis of the cylinder *c d e f*; consequently the curve c_9 f_9 in Fig. 409 will be equal to the curve c_5 d_5 in Fig. 410. Now this fact can be turned into a practical advantage. For instance, let Fig. 409 represent a sheet of metal laid out by the method as previously explained, and then cut to the lines so found. Now, let it be required to lay out a plate for the cylinder *a b c d*. Here all we have to do is to lay the plate shown in Fig. 409 on top of the plate in Fig. 410, and scribe off the curve e_9 f_9, also the straight lines e_9 c_9 and d_9 f_9. We then make the line c_5 a_5 on the lower sheet equal to *a c* (Fig. 408); the line b_5 d_5 equal to *b d*; and join the points a_5, b_5 by a straight line If accurately drawn, the lines c_5 a_5 and d_5 b_5 will be, as they must be, perpendicular to the line a_5 b_5.

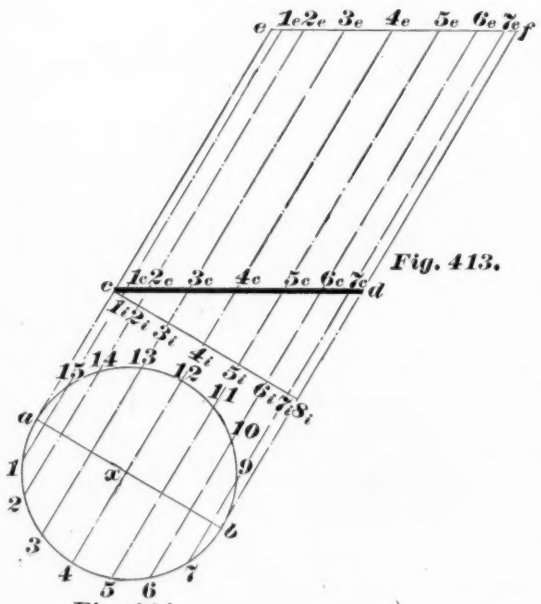


Fig. 414.

In order to lay out the hole o_5 r_5 d_5 in this sheet, we make b_5 o_5 equal to *b o* (Fig. 408); and o_5 p_5 equal to *o p*. The curve o_5 r_5 p_5 must be laid out by the method given in Art. 515. The full lines in Fig. 410 found by the foregoing methods represent boundary lines of the sheet.

518. Fig. 412 represents the development of the whole cylindrical surface *m n o 5r p*. This development, and also the curve *o 5r p* cannot be found without the auxiliary view shown in Fig. 408 *A*. This figure represents a part of the base of the cylinder *a b c d*, and one-half of the cylinder *m n o p*. For our purpose, it is of great importance to place this view in a correct relative position to Fig. 408. To do so, prolong the axis of the cylinder *a b c d*; on this line, and at any convenient distance from the line *a b*, choose a point *x*. Through the point *x* draw the line *x y* perpendicular to the axis. From the point *x* as a center, and with a radius equal to one-half of *a b*, describe the arc *u* v_2 x_2. Draw the line *v* v_2 parallel to *x y*; the distance between these lines must be equal to one-half *m n*; also, on the line *x y*, lay off a point 1; the distance between the points 1 and *u* must be equal to *m o*; through the point 1 draw the line 1—*v* perpendicular to *x y*. From any point *z* on the line *x y*, at any convenient distance above 1—*v*, describe the arc *y w*, whose radius is equal to 1—*v*, and through the center *z* draw *z w* perpendicular to *x y*. This completes our auxiliary view. To find the development shown in Fig. 412, apply the principles and follow method given in Art. 514

519. The curve *o 5r p* in Fig. 408, which represents the intersection of the two cylindrical surfaces, need not to be drawn for the purpose of finding the development in Fig. 412; but for the sake of practice, it should be drawn, and correctly too. To do so, follow the instructions given in Problem 70.

520. A plan, such as is shown in Fig. 411, is not required for finding the developments of the cylindrical surfaces. But on general plans of machinery it may happen that such a view of the cylinders as shown in Fig. 411 must be given; hence the necessity of knowing how to do it. In the first place, let it be required to find the horizontal projection of the cylinder represented in Fig. 408 by the outline *m n o 5r p*. On account of the curve *o 5r p* which is here introduced, and which must be projected in the plan, this problem may appear to be a difficult one; but if we take hold of it in a proper way, we will find that such is not the case; in fact, it is a very simple problem. In Fig. 408 the line *m n* represents the base of the cylinder under consideration, and this base we know to be a circular one. Now, to simplify matters, let us assume that we have to find the horizontal projection of this circular base only, and throw everything else out of mind. In so doing, we find that we have reduced our problem to a very simple one; in fact, it is identical with Problem 51, consequently, to find the horizontal projection of this base, we must follow the instruction given in Problem 51. There we see that the horizontal projection of a circular base inclined to the horizontal plane of projection is an ellipse (see Art. 376). In Fig. 408, the points 2, 3, 4, etc., on the line *m n* have been established for the purpose of finding the development of this cylindrical surface, but these points we may also use for finding the horizontal projection of this base. Consequently, through the points *m*, *n*, draw vertical lines, cutting the center line in Fig. 411 in the points m_2 and n_2, respectively; the line m_2 n_2 will then be the minor axis of the ellipse. Through point 5 draw a vertical line, cutting the center line in Fig. 411 in the point *5n*; on this vertical line lay off a point 5 (Fig. 411) and make the distance between the points *5n* and 5 equal to *y z* in Fig. 408 *A*; the line *5n* 5 will be one-half the major axis. Through point 4 (Fig. 408) draw a vertical line, cutting the center line (Fig. 411) in the point *4n*, and make *4n* 4 in Fig. 411 equal *2z* *2y* (Fig. 408 *A*). In a similar manner find the points 2, 3, etc., and draw a curve through these points, which will be the horizontal projection of the base *m n*.

521. To find the horizontal projection of the curve of intersection *o 5r p*, we have only to apply the principles given in Art. 406. Thus, for instance, the line *m o* in Fig. 408 is an element of the cylindrical surface and the horizontal projection of this element must coincide with the center line in Fig. 411. The points *o* and *m* in Fig. 408 are the extremities of this element. Through the extremity *o* (Fig. 408), draw a vertical line, cutting the center line (Fig. 411) in the point *O*, then the line *O* m_2 will be the horizontal projection of the element *o m*. But the extremity *o* (Fig. 408) lies in the curve of intersection, therefore the point *O* in Fig. 411 must be a point in the horizontal projection of the same curve. Now, let us find one more point in the horizontal projection of this curve of intersection. Take, for instance, the element 3, *3r* in Fig. 408; the points 3 and *3r* are the extremities of this element.

In Fig. 411 the point 3 is the horizontal projection of upper extremity of this element; but we know that this element must be parallel to the axis; we therefore draw through point 3 a horizontal line. Lastly, through the extremity *3r* (Fig. 408) we draw a vertical line, cutting the horizontal line through point 3 (Fig. 411) in the point *3o*. The line 3 *3o* will then be the horizontal projection of the element 3 *3r*, and the point *3o* will be another point in the horizontal projection of the curve of intersection. In a similar manner we find the horizontal projections of the points *4r* *5r*, etc.; the line drawn through the points thus found will be the horizontal projection of the curve of intersection. It must be remarked here that this curve will not be an ellipse.

Directions.—In space marked 76 draw the cylindrical surface *c d e f* only; make *c d* equal to 4 inches, and *d f* equal to 9½ inches; the diameter *i j* is to be 6 inches, and let it bisect the lines *c e*, *d f*. Find the development of this cylindrical surface. Use 3-inch scale.

Also assume that the vertical projection of the four cylinders, Fig. 408, is drawn to a 1-inch scale. Make a sketch of this figure only, and on it mark the dimensions obtained by measurement with the 1-inch scale. Do not measure any other figure. Then lay the AMERICAN MACHINIST aside; and on a 15″ x20″ sheet, make from this sketch a drawing of these cylinders to a 3-inch scale; find the developments of the cylindrical surfaces, and also their horizontal projection.

This should be done without referring to our illustration. Such a course will be excellent practice, and in the meantime may show the student the liability of forgetting to mark on the sketch some of the necessary dimensions, which in practice may at times prove to be a very serious matter. The student should therefore be very careful to mark all the dimensions on the sketch before he commences to make the drawing.

Problem 77.

522. *Development of cylindrical surfaces.*

Let *c d e f*, Fig. 413, represent a cylindrical surface whose transverse section is circular, as shown in Fig. 414. The cylindrical surface is limited by two parallel planes, perpendicular to the vertical plane of projection, and the axis is parallel to the same plane. It is required to find the development of this surface.

We can easily arrange Fig. 413 so that we can apply the solution of Problem 74. Thus, for instance, through the point *c* draw the line *c 8i* perpendicular to the line *e c*, and thus forming a triangle *c d 8i*.

We may now assume this triangle is the vertical projection of a cylindrical surface, and for the sake of simplicity we may also assume that, for the present, it is the only surface which we have to develop; we thus present to ourselves a problem, which is precisely similar to Problem 74. For the sake of completeness and ready reference, hereafter we will give the mode of procedure for finding this development.

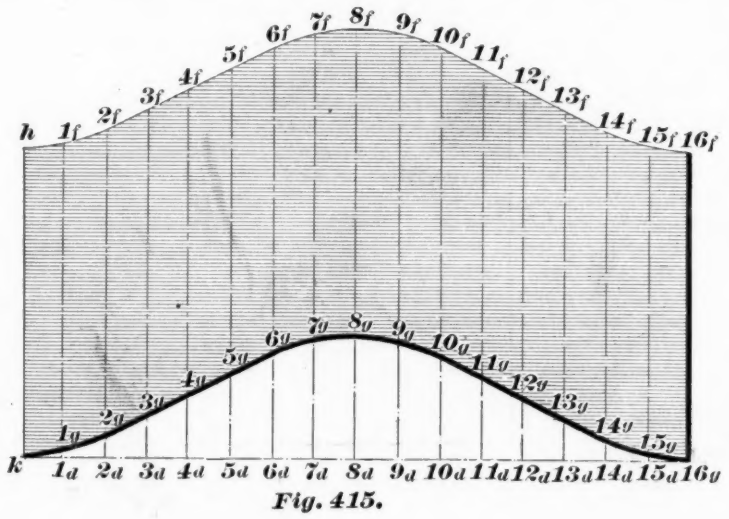


Fig. 415.

Prolong the center line *4e 4c* towards *x*. On this line, at a convenient distance from the line *c 8i*, choose a point *x*; from it, as a center, and with a radius equal to one-half *c 8i*, describe the circle *a b* 4 12. Through the center *x* draw the diameter *a b* perpendicular to the center line *4e* 4. Divide the circumference into any even number of equal parts, say sixteen, and through the points of division 1, 2, 3, etc., draw lines parallel to the center line *x 4e*, cutting the lines *c 8i*, *c d* and *e f* respectively in the points *1i*, *1c*, *1e*; *2i*, *2c*, *2e*, etc. In any convenient position draw the line *k 16g* (Fig. 415) and make it equal to the diameter *c 8i* × 3.1416. Divide the line *k 16g* into as many equal parts as have been spaced off on the circumference *a b* 4 12, and through the points of division *1d*, *2d*, etc., and also through the extremities *k 16g*, draw lines perpendicular to *k 16g*. Make *1d 1g* equal to *1i 1c*, *2d 2g* = *2i 2c*, *3d 3g* = *3i 3c* and so on in succession until *8d 8g* has been laid off, which is equal to *8i d*; then make *9d 9g* equal to *7i 7e*; *10d 10g* = *6i 6c*, and so on in succession. Through the points *k 1g 2g* . . . . *14g*, *15g* and *16g* draw a curve. The surface bounded by the curve *k 8g 16g* and the straight line *k 16g*, will be the development of the cylindrical surface represented by the triangle *c d 8i* in Fig. 413.

Now, after having found in Fig. 415 the curve *k 8g 16g*, there remains but very little more work for finding the development of the cylindrical surface *c d e f*.

Notice that the lines *e c*, *1e 1c*, *2e 2c*, etc., Fig. 413, which represent elements in the cylindrical surface, are all parallel to each other, and terminate in the parallel planes *e f*, *c d*; therefore the lines *e c*, *1e 1c*, *2e 2c*, must all be equal in length. Consequently, make each of the lines *k h*, *1g 1f*, *2g 2f*, etc., Fig. 415, equal to *c e*, and through the extremities *h*, *1f*, *2f*, etc., draw a curve. The shaded

portion in Fig. 415 will be the development of the cylindrical surface *c d e f*.

Directions.—In the space marked 77, draw the outline *c d e f* to represent a cylindrical surface, diameter = 5 inches; length of element *e e* = 7 inches; the angle *e f d* = 60 degrees. Find the development of this surface. Use a 3-inch scale.

Self-Instruction for Young Mechanics.

By Frank Richards.

I.

From the very beginning, and all the while, please to bear in mind the title of these little papers, because I mean the title to be a truthful one. I am not setting out to teach the young mechanic, or anyone else; for I am myself only a learner. All I can hope to do is to point out some of the opportunities for learning and discipline that are open to everyone, with the hope that some will take advantage of them. I cannot promise how far I will go, because the road beyond a certain point is unfamiliar to me. We will not set out for any distant goal, but wander along as we may, and pick up what we can as we go.

It is a great thing to be able to see and know our opportunities when we have them. I have no doubt that many of us, while desiring them earnestly enough, miss them with eyes wide open, from our utter inability to recognize them when they are right before us. But many more miss them because their minds and eyes are otherwise occupied than in looking for them. One of the commonest of bad habits, and one of the most unprofitable ways of wasting time, is in mourning the lack of opportunities. I am only severe as the truth is severe, when I say that I have never known one so engaged who had honestly used, or who was honestly using, the opportunities that he had. It is childish to cry over spilled milk, but it is imbecile to stand beside the cow, and whine because the milk is not in our pail.

Young mechanics complain about as much as any class, about their lack of opportunities for advancement. I suppose that I should surprise many of them if I told them, as I am now setting out to do, that they have great and peculiar opportunities for self-improvement.

One thing is, that there is so much to learn. I suppose that no one, however desperate, will be rash enough to dispute that. Of old, all roads led to Rome, and so from Rome one could reach the uttermost parts of the earth. To-day, machinery and the mechanic seem to have ties reaching out to the remotest corners of the universe of knowledge. There is no such thing as learning it all. The most diligent and successful only learns what he can; and the learning is kept up as a life-long habit by everyone who marches near to the front, which is in itself a sufficient refutation of the too prevalent idea, that the schools can turn out a man fully and permanently equipped. Schools of instruction are followers, and not leaders. They reproduce and impart what has been first gathered by independent students, and given to them. The most advanced knowledge is all first acquired by individual research, and all that we know has been in its turn the top of the store of knowledge then existing. Independent thought and investigation, which is only another name for self-instruction, is thus the pioneer of the world's progress, and, in its results, at least, is honored by all. So self-instruction is a commoner thing, and yet a nobler thing, than many are apt to think it.

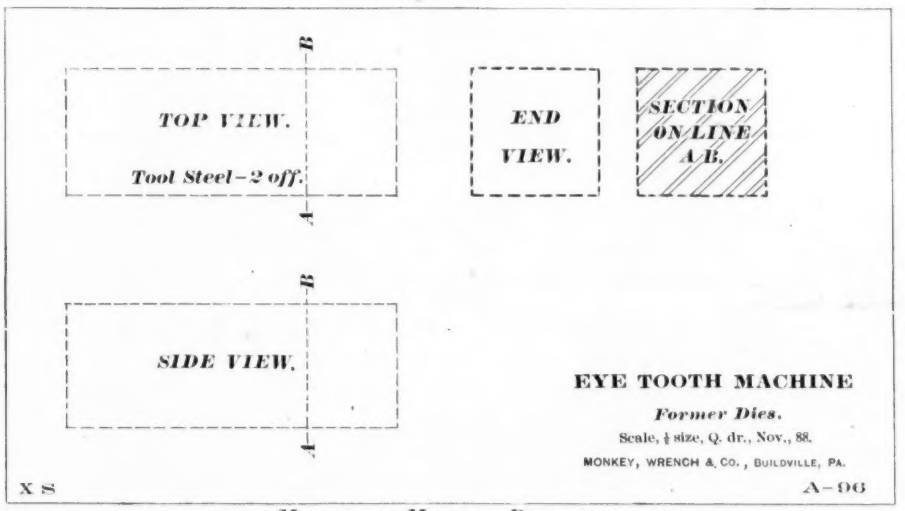
With all the fields of human knowledge open to him, and inviting him to enter, the young mechanic is in a peculiarly favorable mental condition for availing himself of the opportunity so presented. The disadvantages the young mechanic is apt to think he labors under are, in fact, his advantages in disguise. The machinist's occupation has two very different sides to it—the manual and the mental. One who can be content to exercise only the manual side will escape some discomforts. Some things about his lot we could almost find it in our hearts to envy. There will be no uphill work for him to do. If he cannot stand comfortably where he finds himself, there will always be an easy path downward. One who cultivates the mental side of the trade does not choose a way that is all roses and sunshine, but it leads him into fresh fields and pastures new. When the manual and the mental sides are both cultivated, the one may become a relief from the fatigue entailed by the other. The mental cultivation may, if you choose, be made the young mechanic's hobby, and, worked accordingly, it then becomes a recreation, which is in itself an indirect help, and, in the knowledge acquired, or in the mental training accomplished, a very positive gain. I offered a few remarks in these columns the other day, about the hobbies of machinists. If anyone thought the topic a frivolous one, he did both it and me injustice. The hobby of the young machinist, the recreative occupation that fills the intervals of leisure, and relieves the fatigue of shop work, may do much to lift him to a higher position. I do not know how the clerk or salesman in a store, could apply his leisure, as a means of self-advancement in the line of his regular business, to as good advantage as the mechanic can.

In the domestic bearing of this, I suppose that many a mechanic has experienced some unjust reproaches. A neighbor, whose occupation is clerical and sedentary, finds relief and amusement in manual employment. He is handy about the house, and he has some mechanical skill, and he makes some articles for ornament or use that are much praised and prized, and the wife of the unfortunate mechanic is unable to understand why he can't do such things. It is the old story of the shoemaker's wife or the blacksmith's horse. I am willing to think that it should be a reproach to the fabricator of foot-gear to have his wife or his horse too sumptuously provided for. A fellow naturally and properly does not want to be doing the same style of thing in his hours of leisure that he has been doing all day long, and I am calling his attention to the fact that, instead of that, he can do what in the long run will be more profitable as well as more satisfactory. The clerk may be handy with his tools in his leisure moments, and let him make the most of it, and get all the domestic glory that he can out of it; but still he cannot be helping himself along in his business as the mechanic can.

Another advantage in disguise the young mechanic often has in the matter of location. The fact of being tied down in a small place, in a little country town that only feebly feels the pulsings of the big world, is often deplored as a lack of opportunity. It is a mistake. It is all the other way. I know that the cities offer some apparent advantages, but they are offset and overbalanced by their enticements. There is always so much going on, so much to be seen, and heard, and done, that the valuable time is all broken up and frittered away. In the quiet country towns the circumstances are so different that they may be said to be entirely reversed. There the influence of the surroundings impels the young man to study instead of drawing him away from it. Many who, in the cities, would rush with the gaping crowd after every fresh excitement, in the country places are actually driven to reading and study as a means of occupation for the heavy hours of leisure. I should not expect to find the most diligent readers and students of the American Machinist in the large cities. It is notorious that the country boys have taken and are taking the prizes of life in most of the fields of usefulness, and it is as true of the machine shop as elsewhere.

Even about the superior facilities the cities are supposed to offer, when I come to look for them I cannot find them. Beginners do not need elaborate and costly appliances. Voluminous text-books and intricate apparatus would be more likely to frighten than to help those that I am trying to advise. Then, as to the professional teacher, it continually astonishes me to realize how little he can help the young mechanic in his elementary studies, and yet how ready the young mechanic is to bemoan the lack of his assistance.

In all this I am in no sense trying to make the best of what is not best. In all sincerity, the young man may be thankful if his surroundings are favorable to habits of studiousness. Circumstances count for much; and if the narrowness of one's lot concentrates the energies and fixes the resolution as nothing else can do, then circumstances may be said to be at their best. There is a providential arrangement that continually invites the worthy up higher, and the country boy will find himself in the larger place as he is ready to fill it. When the studious habit is fixed, enticements will be powerless; the superior advantages as they arise will find fuller appreciation, and be used to more substantial profit.



Manner of Marking Drawings.

LETTERS FROM PRACTICAL MEN.

Some Ideas by a Draftsman.

Editor American Machinist:

The office of the drawing-room is simply to conceive and make clear to the hands the necessary information to construct the machinery built by the shop. The usual form of this information is a drawing, tracing or blue print, but the addition of a few printed blanks for ordering material is a great convenience. The main thing in a drawing-room is clearness, and all other things should be subordinated thereto; fancy lettering, diagonal barred fractions and other "stylish" things are not wanted. A certain amount of method helps wonderfully the efficiency of the drawing-room; but I advocate the least which secures the best results. If you will start with only a little, your needs will develop the method you want. Do not try to enforce iron-clad rules or inflexible system, but make things as elastic as good work will permit. The methods of one shop will not exactly fit any other shop, so evolve your own. You can start with these few rules as pretty sure to fit anywhere:

Furnish all necessary information cheerfully, receive all suggestions courteously, and do not imagine that you possess the entire brains of the establishment. Cultivate good feeling between all departments of the shop, and never interfere with a foreman or his men. Do not allow any information to leave the drawing-room until a record of it is left there. Insist that drawings are not to be departed from, unless by order of the drawing-room, and then make your drawing show the departure. The drawing-room should be the point of distribution for all orders relating to the building of work; by following this rule, much friction and confusion is avoided, and the responsibility is centered in one place.

The drawing-room should have only one head, and no one else should be allowed to give orders. This head should be the designer, and responsible to the firm only; and under his supervision the draftsmen work out details of size, shapes, etc. To the designer are furnished by the firm such data as are necessary; from these he works up his sketches and calculations, and these, when approved by the firm, he hands over to a draftsman, who makes one or more scale drawings, showing as much of the machine together as possible. When these drawings are approved by the designer they are inked up, colored and figured. These drawings should be as complete as possible, and contain information as to speeds, etc. These drawings are best made on good quality white paper, and are office drawings only.

The work for shop use may be in the form of tracings of above drawings on paper, colored, mounted on boards and varnished; or each piece may be detailed separately. This latter should be done with forgings in all cases. When detail drawings are made, make them in pencil on brown paper, and trace on linen, then blue print for office and shop use. Do not ink up or finish pencil drawing, as your tracing is a finished drawing. Do not litter up a drawing intended for the machinist, with a lot of pattern maker's figures, but make either separate paper tracings of each piece, or make a print from tracing, and add to the print such figures as the pattern maker needs. All drawings give finished sizes, unless otherwise marked, and allowance for finish, draft, etc., is left to the smith or pattern maker, unless it is something special, in which case it should go on the drawing.

My suggestions as to the method of a drawing-room are as follows: Let the drawing room order material and furnish all orders for building of machines to the various foremen. Let it get the drawings, etc., up in such shape as it thinks best, and let it regulate its own internal affairs. In making drawings, adopt certain sizes and keep to them. Say, 24x36, and 18x24, and 12x18 for sketches, office drawings and tracings, and for casual sketches of odds and ends use paper of letter size and note size. Make these sketches with copying ink, and copy them into an ordinary letter book, as a means of retaining a record. The relative position of views to be that known as the "American plan," *i. e.*, the view of any part on the side nearest to it, so that, if one view is bent down around the edge of another, everything comes as it will on the machine. Show three views on construction drawings; avoid dotted lines, and use sections to replace dotted lines when practicable. In order to easily distinguish drawings, give each a distinct title and number. For instance, give numbers to drawings consecutively, without regard to size, except to prefix to the number a letter (which indicates size only), as *A* for 24x36, *B* for 18x24, and *C* for 12x18 sizes. This and the like should appear in lower right-hand corner of drawing, in all cases.

Thus each drawing has its own individual number. When tracings are exact duplicates they take the same number as the drawing, but if they differ by additions, changes or otherwise, they will take numbers as if they were new drawings.

All drawings must be inked up or traced, and drawings and tracings are to be kept in different drawers. Do not put too many in one drawer—fifty is plenty—and have drawers suited to the sizes, putting on outside of each drawer the lowest drawing number contained in drawer, and when full, add to it the highest drawing number. On office drawings on sections, use conventional tints

on tracings; for blue printing use cross-hatching or section lines. The conventional tints are: Cast-iron, Paynes gray; wrought-iron, Prussian blue; steel, red-purple; brass, chrome yellow; copper, brown-red; babbitt, light green; wood, yellow ochre, burnt umber.

Whenever there may arise question as to the material, put the name on the piece plainly. Do not allow measuring of drawings; mark finish on castings where it is wanted by letter *f*, with the bars crossing on the line of finish. Each pattern is to have a number of its own stamped on it with steel figures.

Every drawing for shop or office use must have on every view of every casting, *f* marks and pattern numbers. Forgings are to be finished all over, unless otherwise marked. It is a good plan to number up forgings, too—in this case begin at No. 1 on each machine. The following rules for figuring drawings are slightly modified from the excellent directions of a prominent shop:

1. Figure in inches up to 24 ins., and in ft. and ins. for sizes above that.

2. Use the abbreviation ft. for feet; no other designation is needed, as measurements are understood to be in inches unless otherwise marked. Never use "tick" marks.

3. Do not figure on center lines nor on the lines of the drawing; keep figures in open space as far as possible.

4. Use dimension lines of reasonable length; do not make them too long or too short.

5. All figures, etc., to read from bottom and right hand of sheet.

6. Figure in continuous lines, and put figures where they will show most plainly.

7. Over-all sizes are to appear always, and figure from finish to finish, or to centers.

Pattern numbers, finish marks, dimension lines, arrow heads and center lines, are to be in red ink. Use as large scale as possible, and remember that the fewer lines and figures which will show clearly what is wanted, the better the drawing. If possible, proof-read all drawings.

The drawing-room, by use of tracings or blue prints, or both, and the "copy book" aforesaid, can always have record of its drawings. One book is kept for record of consecutive drawing numbers, and one for a list of all drawings used on each machine; thus any drawing can be quickly and conveniently found. The ordering of material, patterns, etc., needs records also, and some blank forms for convenience. One book is kept for the record of consecutive pattern numbers. One book is kept for record of castings and pattern numbers on each machine. One book is kept for record of forgings on each machine. Included in this book can be all stock-room material, such as drop forgings, washers, bolts, nuts, springs, etc.

These books should be ruled to suit the needs of the shop, and should include weights, material, number wanted, etc. For the blank forms needed, have one for pattern shop, telling what pieces are to be made new, altered, etc., for each drawing. Have one for foundry, telling how many castings are wanted for one machine, and the number of machines ordered. Have one for smith shop, telling how many forgings are wanted for one machine, and the number of machines ordered. Have one for stock-room, giving same information as to stock. When any material is bought outside, let the drawing-room order from the office, and the office make the purchase. All these orders or forms are ruled to include weights or other information, and are to be filled in and returned to drawing-room promptly. Have all your drawings, blue prints and sketches returned promptly also. In addition to the above, I recommend the keeping of a book containing the calculations and data relative to each machine. To recapitulate the order of the work, the following is given as a guide:

a. Drawings, made on order from office.

b. Patterns, made on order from drawing-room together, with drawings, and furnished to foundry.

c. Castings, made on order by list from drawing-room.

d. Forgings, made on order by list from drawing-room, together with drawings.

e. Stock, furnished on order by list from drawing-room.

f. Machine, built and shipped on order of drawing-room.

Section *b*, in the case of a machine where patterns are made, should read:

b. Patterns furnished to foundry on order by list from drawing-room. TAU.

Comparison of Gas Engines with Steam Engines for Small Powers.

Editor American Machinist:

Having occasion to purchase a small engine, I supposed that a gas engine would be the most economical for my purpose; but, after making careful inquiries, I have reached a conclusion which may be as interesting and instructive to thousands as it is to myself. The manufacturers of small gas engines make great claims, and give plausible reasons in support of statements that do not seem to me to be able to stand a close comparison with the claims of the makers of small steam engines.

I wanted a power that would run all the way from one to seven or eight horse-power, and average about four horse power, and, in addition, I had to provide heat for a shop eighty by thirty feet in dimensions.

I compared a well-known make of small automatic cut-off steam engine, with a gas engine that makes its own gas from gasolene, with the following results:

The steam engine sells for four hundred dollars, complete, with boiler and all necessary fixtures, and to carry this at six per cent. interest, taxes, repairs, etc., is worth forty dollars per year. The makers claim that it will use about four pounds of coal per horse-power per hour, and this, for an average of four horse-power for ten hours a day, and three hundred days a year, with coal at five dollars per ton, will cost one hundred and twenty dollars per year. Such a small engine requires no special engineer; any good mechanic being able to take entire charge of it, and seventy-five dollars per year is sufficient to allow for attendance. The exhaust steam will nearly heat the shop in the coldest weather, is all that is required in mild weather, can be used to heat the feed-water in warm weather, and is worth at least fifty dollars a year. Therefore, it appears to me that the automatic steam engine will give me an average of four horse-power for a year, at an expense of one hundred and eighty-five dollars, or less than forty dollars per horse-power per year.

On the other hand, the gas engine can be put in for eleven hundred dollars, which, by the way, is about three hundred per centum profit, and will cost one hundred and ten dollars per year to carry. The makers claim that it will cost one cent per horse-power per hour with gasolene at ten cents per gallon, but as the gasolene will cost the user at least fifteen cents per gallon, in the quantities he must use, and delivered in position to use, the cost will be one and one-half cents per horse-power per hour, or one hundred and eighty dollars for four horse-power for a year. The attendance on the engine is at least twenty-five dollars per year. If a gas engine is used, stoves or a boiler must be provided for heating the shop, and, with attendance and extra fuel, will cost at least seventy-five dollars a year. This gives a total cost of three hundred and ninety dollars per year.

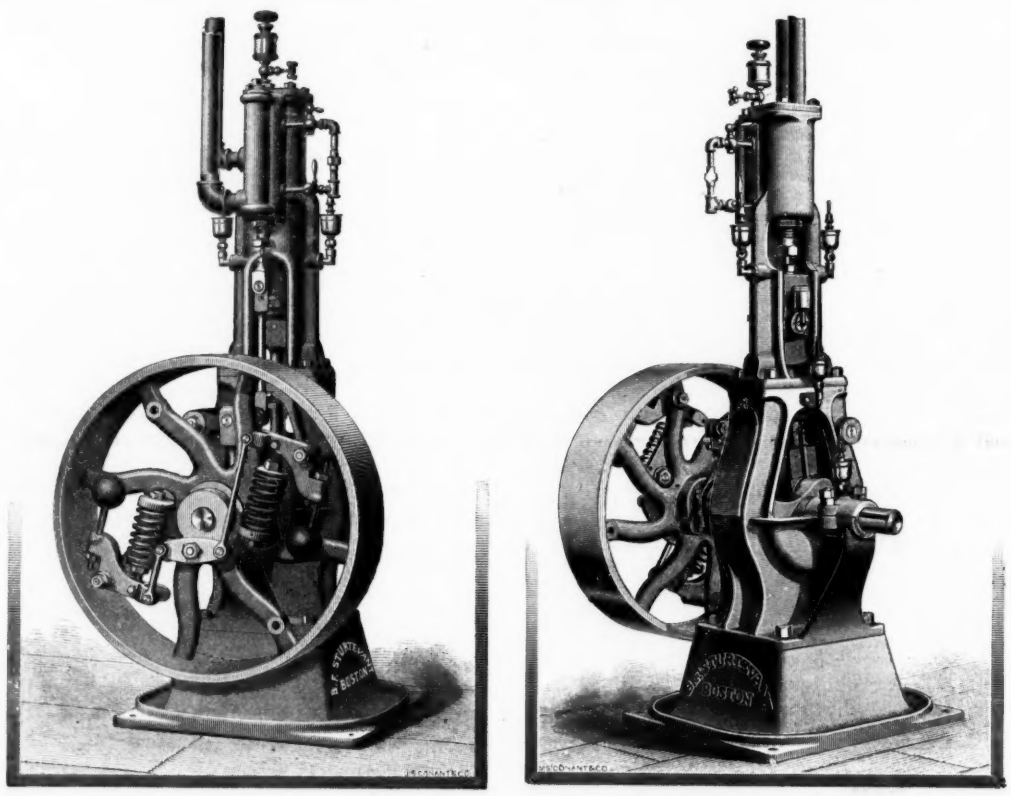
From this reasoning it appears to me that it will cost me twice as much to provide such a small power, and heat my shop by the use of a gas engine, as it will by the use of a steam engine, in spite of the statements of the gas engine makers to the contrary. If I am wrong I should be glad to be corrected with the figures and facts.

There are thousands who need small powers, and therefore the matter is an important one, and well worth careful consideration. The comparison will be still more against the gas engine if the gas must be purchased from the city.

I requested the makers of the gas engine to show me where my comparison was wrong, and received the following very conclusive argument: "We do not care to figure on relative cost of your . . . . automatic steam engine and the . . . . (gas engine), neither of operation nor the first cost. If the advantages of the . . . . are not there, of course you can't see them; if they are there, you can see them as well as any one." I have looked at the matter from the point of view of the makers of the respective engines, and have taken their own figures as to the consumption of fuel, and yet I cannot see the advantages of the gas engine for a steady running small power. It is to be acknowledged that, for an intermittent power, in the hands of a person who is no mechanic whatever, to grind coffee for five minutes in a grocery, or pump an organ once a week in a church, the gas engine has no rival but the water motor, but I am not now ready to admit that it compares with the steam engine under ordinary circumstances, and according to the claims and statements of their makers.

Boston. GEO. B. GRANT.

[If our correspondent is so fortunate as to secure a steam engine developing only four horse-power, and for which the total consumption of coal will be but four pounds per horse-power per hour, he will, we believe, do something never before done.]



UPRIGHT AUTOMATIC ENGINE.

Upright Automatic Engine.

We present with this, engravings showing two different views of a single valve upright automatic engine made by B. F. Sturtevant, Boston, Mass.

This is a center crank engine, having a shaft governor, the principle of which is much the same as that used in most shaft governors. Two weights, by their centrifugal force, tend to compress two powerful springs, and, through the connection shown, cause the eccentric to swing across the shaft, varying its throw and the travel of the valve, according to the lead. The point of cut-off is thus variable, from zero to seven-eighths of the stroke, and a very economical distribution of steam secured. The governor wheel, owing to its weight, serves as a fly wheel, and may be utilized as the driving pulley, though the opposite end of the shaft is splined, to receive an additional wheel for driving, if desired. The direction of rotation of the engine may be easily changed, by transferring to the empty holes in the arms of the wheel, the studs which carry the weights and levers, and at the same time reversing the position of the weights, levers and springs.

The valve is of the balanced piston type, accurately ground to a fit, and so arranged as to avoid all danger from water in the cylinder.

The valve, having no unbalanced lateral forces acting upon it to produce wear, the governor comparatively little motion of its parts after the engine is up to speed, and all moving parts being of steel, with ample bearings, ensures minimum friction with great durability. Special continuous oiling devices are provided, ensuring cool bearings and continuous running at high speeds.

The light curved plates upon the sides of the frame may be readily removed, to give access to the crank and connections, and, while in place, prevent the escape of any oil which may be thrown by the running parts.

The lower portion of the base forms a basin in which the oil and water may collect, and from which they may be removed through a pipe inserted in the bottom. A rim around the sub-base prevents any oil or water, not otherwise collected, from running onto the floor. The crank is accurately counter balanced, and steady running is ensured at the tabulated speed.

The pin is of maximum size, and is oiled from a stationary sight-feed oiler attached to the frame of the engine. All other stationary oil cups have sight-feed, and those upon moving parts are closed, to prevent leakage. All moving parts are as light as is consistent with the required strength, and the parts are simple, easily reached, and easily adjusted.

As a substitute for the ordinary upright throttling engine, this engine has all the well-understood advantages of close regulation, and an economy in the use of steam, which is attainable only by automatic variable cut-off.

Four standard sizes are built, with cylinders 4″×4″ to 7″×7″, the former being intended to run at 450 revolutions per minute. Special sizes are built to order to suit varying conditions or requirements.

A Board of Trade report, by Major-General C. S. Hutchinson, has been published on the boiler explosion which occurred on the 17th July, about seven miles from Shildon, on the Impasture Mineral Branch of the North-eastern Railway. This engine, No. 590, was a six wheel coupled goods engine. It appears that the barrel of the boiler, which had commenced working in 1879, and had run about 220,705 miles, exploded while the engine was

running with a train of twenty-eight loaded mineral wagons and a brake van—twelve less than its maximum load—at a speed of about twenty miles an hour, down a falling gradient of 1 in 200, about seven miles from Shildon, where it had commenced its journey. The driver, an experienced man of twenty-nine years' service as such, and who had had charge of the engine for 8½ years, states that it had been running about a mile with the steam slightly on, it having been previously shut off for two or three miles, the injector having been taken off when steam had been put on, when, without the slightest warning, the explosion took place, the pressure gauge having indicated 120 lbs. just before this; that steam had not been blowing off at the safety valves the same morning, but had been the day before at 130 lbs. With boilers made like this one, with lap joints, grooving is far more likely to be produced than with those made with butt joints, and I am glad to learn from the locomotive superintendent of the Northeastern Railway that he is making all new boilers with butt joints. It is satisfactory to observe how few locomotive boiler explosions now occur, compared with their former frequency, especially on the Northeastern Railway.—*The Engineer*, (London).

Notes on the Expansion of Steam.

BY RICHARD H. BUEL.

FIFTEENTH PAPER.

In bringing this series of articles to a conclusion, an attempt is made to present the general results of the calculations in such a manner as to show clearly the effect of changing the point of cut-off in steam engines, jacketing the steam cylinders, and using superheated instead of saturated steam. The tables here represented will be found valuable for reference by steam users. Table *P* shows the requisite sizes of cylinders to develop 150 effective horse-power, using steam with an initial pressure of 100 pounds per square inch. Other things being equal, the first cost of an engine is proportional to the size of steam cylinder; and this table illustrates in a striking manner the advantage of employing a condensing engine, whenever possible, if the cost of the steam plant is a matter of importance. But it would not be desirable to purchase an engine simply because it was cheap, since the cheap engine might be wasteful, necessitating a large outlay for operating expenses and steam-generating plant. Table *Q*, giving the cost of operation, as illustrated by the steam consumption, contains data that should be of interest to every owner of a steam engine.

The reader will remember that, although the results contained in this table are obtained by theoretical calculations, they compare very favorably with the figures of actual practice; the assumed conditions being made to conform, as nearly as possible, to the real conditions found in the operation of steam machinery.

In Table *Q* the data for effective horse-power and hourly consumption of steam are copied from preceding tables, and two sets of comparisons of the steam consumption are added. In the lines giving this comparison, "For different points of cut-off," the comparative values are to be read vertically, since they show the relative economy of operating the engines in each manner indicated, and for each point of cut-off. For example, it appears from the table that, in the case of non-condensing engines using saturated steam in steam-jacketed cylinders, the most economical point of cut-off is ¼; the economy is only slightly diminished for cut-offs of ⅛ and ⅙; for a cut-off of $\frac{1}{12}$, the steam consumption is 29 per cent. greater than at ¼, and so on.

In making the comparison of economy "for different modes of operation," the comparative values are to be read horizontally, giving the relative economy of various methods of operation at the same points of cut-off. Thus, for a cut-off of ¼, the most economical manner of operating it is to use superheated steam in a condensing engine with unjacketed cylinder; if the condenser is removed, the steam consumption will be increased 28 per cent., and so on.

P.—Expansion of Steam. Dimensions of Steam Cylinders. Diameter × Stroke, Inches.

Point of Cut-off.	*a.*—Steam Cylinders Proportioned for 150 Effective Horse-Power. Non-Condensing. Dry Saturated Steam, not Jacketed.	*b.*—Steam Cylinders Proportioned for 150 effective Horse-Power. Condensing. Dry Saturated Steam, not Jacketed.
Full stroke.	14 ×28	13 ×26
¾	14¼×28½	13¾×26½
½	15¼×30½	14 ×28
⅜	17¼×34½	15¾×30½
¼	19 ×38	16½×33
1-6	23 ×46	18½×37
1-8	27 ×54	20¾×40½
1-12	34¾×69½	23½×47

Q.—Expansion of Steam—Summary of Results.

Item.	Point of Cut-off	Non-Condensing Steam Cylinders *a*.			Condensing.			
					Saturated Steam, Unjack'd Cylinders.		Steam Cylinders *a*.	
		Saturated Steam, Unjacketed Cylinders.	Saturated Steam, Jacketed Cylinders.	Superheated Steam, Unjacketed Cylinders.	Steam Cylinders *a*	Steam Cylinders *b*	Saturated Steam, Jacketed Cylinders.	Superh't'd Steam, Unjacket'd Cylinders.
Effective Horse-Power.	Full St'ke	150.6	150.6	150.6	177	152.5	177	177
	¾	151.5	150	151.5	178.9	154.3	177 3	178.9
	½	148.8	147.1	148.8	180.	152	178.7	180.2
	⅜	147.5	143.8	147.5	188	150 4	184.6	188
	¼	150.6	142.6	150.6	202.3	151.1	195.1	202.3
	1-6	148.8	139.4	148.8	228.6	148.6	219.1	228.6
	⅛	149.8	139	149.8	257.3	148.7	245	257.3
	1-12	150.1	133.6	150.1	321.9	150.1	300.3	321 9
Pounds of Steam Hourly per Effective Horse-Power.	Full St ke	40.7	38.9	38.8	35.9	36.8	33.3	33.2
	¾	39.3	33.5	36.6	34.7	31.5	28.6	31.2
	½	30.3	27.9	26.6	26.6	27.1	23.5	22.4
	⅜	28.6	25.2	23.7	24.5	24 1	20.4	19.3
	¼	28.	24.5	22.1	23.4	23.9	18.8	17 3
	1-6	30.2	25.1	22	23.4	23.7	17.4	15 9
	⅛	34.9	26.7	24.2	24.6	24	16.5	15 7
	1-12	42.2	31.6	26.1	24.8	25.8	15.9	13.9
Relative Weights of Steam Hourly per Effective Horse-Power. For Different Points of Cut-off.	Full St'ke	1.45	1.59	1.76	1.53	1.55	2 09	2.39
	¾	1.40	1.37	1.66	1.48	1.33	1.80	2.24
	½	1.08	1.14	1.21	1 14	1.14	1.48	1 61
	⅜	1.02	1.03	1.08	1.05	1.02	1.28	1.39
	¼	1	1	1	1	1.01	1.18	1.24
	1-6	1.08	1.02	1	1	1	1 09	1.14
	⅛	1.25	1.09	1.10	1.05	1.01	1.04	1 13
	1-12	1.51	1.29	1.19	1.06	1.09	1	1
Relative Weights of Steam Hourly per Effective Horse-Power. For Different Modes of Operation.	Full St'ke	1.24	1.17	1.17	1.08	1.11	1	1
	¾	1.37	1.17	1.28	1.21	1.11	1	1.09
	½	1.35	1.25	1.19	1.19	1.21	1.05	1
	⅜	1.48	1.31	1.23	1.27	1.25	1.06	1
	¼	1.62	1.42	1.28	1.35	1.38	1.09	1
	1-6	1.90	1.58	1.38	1.47	1.49	1.09	1
	⅛	2.32	1.70	1.54	1.57	1.53	1.05	1
	1-12	3.04	2.27	1.88	1 78	1.86	1.14	1

The figures representing the hourly steam consumption per effective horse-power, for condensing engines, both when using saturated steam in jacketed cylinders, and when using superheated steam in unjacketed cylinders, compare favorably with the best results obtained for double, triple and quadruple expansion engines. This is as it should be. If the losses from condensation and radiation can be prevented, the chances for economy are more favorable in the case of the single cylinder engine than when several cylinders are used. Double, triple and quadruple expansion engines have special advantages of their own, principally in the more even distribution of the strains, rendering it possible to use high grades of expansion without employing fly-wheels; but probably no engineer who has studied the question will assert that such engines are necessarily more economical than well designed simple engines. They *are* usually more economical, it is true, because well designed simple engines (meaning thereby engines in which effectual means for preventing the usual loss of heat are provided) are somewhat rare. Unless the figures given in Table *Q* are utterly false, land engines with single cylinders, where the space and weight of the necessary fly-wheels are not objectionable, can be operated at as high rates of expansion, and as economically, as the best examples of marine practice, continuing the expansion through several cylinders.

The means to this end have been indicated in the present discussion. They consist principally, when the initial pressure is fixed, in reducing clearance, back-pressure and friction of moving parts, using steam free from moisture, and either providing efficient steam-jackets or superheating the steam sufficiently to prevent all condensation.

Experiments have been made in Berlin with india-rubber for street pavement. It is said to be very durable, of course noiseless, and unaffected by heat or cold. As a covering for bridges it is said to have peculiar merits, its elasticity preventing vibration.

Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

BY W. H. HOFFMAN.

TWENTY-SECOND PAPER.

By referring to the general dimensions of our proposed steamship, it will be noticed that we have a liberal space for engines and boilers, and the figures given below will readily show the relative position of the shaft with the keel, at or near the midship section. The vessel will be 350 feet long, 40 feet beam and 27 feet depth of hold. Under the above conditions there can be no excuse for cramping the steam machinery. Comparing the English vessels of the same tonnage, we have an increase of length of at least 30 feet, and an increase of depth of hold of 2 feet. The draught of our vessel forward will be 16 feet 6 inches, and the draught aft 17 feet 9 inches.

Our cranks and connecting rods will require a clear space for their swing of 84 inches, and this gives us the correct distance between the longitudinal stringpieces of the main bed plates.

Our rule for the width athwartships of the body of the legs of the upright girders is that they shall be ½ the total height of the girder, and this will make them 27 inches wide, exclusive of any flanges. The body of the uprights then will be 16 inches wide at the upper stem, and 27 inches wide where they join the lower flanges.

The flanges will project from the body 4½ inches all around. The depth of each of the lower legs in a fore and aft direction will be 13½ inches, or one-half the width in a transverse direction. The whole width of the lower upright flanges will be 36 inches in a transverse direction, and 22½ inches in a fore and aft direction; an unusually large footing surface, when it is considered that there will be four such flanges to each set of uprights, or twelve in all.

The corners of the main upright stems and those of the legs will be rounded on a radius of 3 inches. The outside curved portion of the uprights will be 1⅜ inch at the top, and 2 inches at the bottom, while the inside thickness, next to the slides, will be 1¼ inch thick at the top, and 1⅞ inch at the bottom. The sides of all the uprights will have a fore and aft thickness of 1¼ inch. The distance between the inside bodies of the beds being 7 feet, and the transverse width of each girder being 27 inches, the total distance from outside to outside of the girder legs will be 10 feet 6 inches, while the inside and outside distances of the main bed-plate stringers will be 7 feet and 10 feet 6 inches respectively. At the junction of each of the cross-ties or girts, that connect the two longitudinal stringers, there will be a projection on the inside and outside of the stringers of 4½ inches, and these projections will match the flanges on the upright girder frames. The edges of these lower flanges on the upright frames will be planed so that each pair of legs will join, the distance from outside to outside being 7 feet. The lower portion of the legs of the uprights will be curved outward from the center, joining an inward curve that will nearly reach to the top of the girder. I shall not here give the dimensions of the radius of the several curves, as these descriptions will be illustrated in a general way hereafter. At a distances of 30 inches from the top of the upright girders there will begin an inward projection on each girder, equal to the depth of the jacket, with ⅝ inch added for clearance, and this projection will extend to the lower end of the guides. This space of 30 inches is left in order to drop the lower cylinder heads that distance, and thus permit a thorough examination of the cylinders from the lower ends.

To hold the upper ends of the guides, there will be two square steel studs that will be removed before dropping the cylinder heads. By casting this projection on at this point, we add materially to the strength of the uprights, and thus fully compensate for the curvature of the frames.

In fitting up the girders in the shop, they will first be placed in a lathe on centers, and the top and bottom flanges will be squared up to steel gauges. The girders will then be placed on centers attached to a large planer table, where the guide seats and the edges of the leg flanges will be planed to gauges. The drilling of the holes in the flanges can be done by a special traveling fixture, bolted to the planer table, so that the drilling and the planing can be done at the same time. Such special attachments are now in use for boring and facing, while the planing process is in operation, and they can be arranged to drill by simply extending the range of the movement of the drilling head, and by modifying the speeds and feeds. By this method all the holes can be drilled square with the planing, and the saving in time is very great.

A word just here in regard to squaring up engine frames and columns in a lathe.

I believe this work is usually done by an ordinary lathe, fitted with the common type of compound rest, but I have yet to see a lathe of this character that will turn out true and reliable work, unless the feed is very fine; too fine, in fact, for economic shop practice. Every engine shop that uses a lathe for squaring up the engine frames or columns, should build a rest for their particular work, if the tool builder does not furnish a suitable device. A rest that will turn out perfect work is not necessarily expensive, and can be readily attached to any strong lathe. The rest will be fitted to the Vs of such a lathe, the main rest casting being a simple deep-flanged girder, or truss, extending across the shears of the lathe. On the top of this girder will be planed a seat for the transverse tool block, said block being at least 5 inches deep over the top of the seat, while the gibs should be 2½ inches deep, and 2¼ inches wide. The lower block will have a movement that will extend quite to the center of the lathe, but the top block will have a travel of only 5 inches. The bearings of the main casting, where they rest on the shears, should be 5 feet long.

There should be two such rests, and they would ordinarily be fitted to a lathe that would swing from 8 to 10 feet over the shears and that would receive a piece 20 feet long on its centers.

It is reported that a company has been formed at Pittsburgh, Pa., that proposes to enter on a gigantic scale into competition with the railroads for the freight business of such parts of the West and South as can be reached by water. The company expects to build several large steamboats, and a large number of barges.

This is the time of the year when those railroad companies whose rolling stock is in noticeably poor condition put their shopmen on short hours.

AMERICAN MACHINIST

To prevent delays all Communications should be addressed to the Company.

PUBLISHED WEEKLY
BY
American Machinist Publishing Co
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

Subscription.

$2.50 a year in advance, postage prepaid in the United States, Canada and Mexico.
$3.50 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 BOUVERIE STREET, Fleet Street, LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY
The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R.I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y

NEW YORK, DECEMBER 27, 1888.

CONTENTS.

	PAGE
Seventeen-Inch Manufacturers' Lathe	1
Practical Engine Testing. By W. H. Booth	1, 2
Crystallization and Shrinkage of Cast-Iron	2, 3
A Safety Set Collar	3
Practical Drawing. By J. G. A. Meyer.	4, 5
Self-Instruction for Young Mechanics	5
Letters from Practical Men—Comparison of Gas Engines with Steam Engines for Small Powers. By Geo. B. Grant	5, 6
Upright Automatic Engine	6, 7
Notes on the Expansion of Steam. By Richard H. Buel	7
Design, Construction, Repairs and Management of Marine Steam Engines and Boilers. By W. H. Hoffman	7
Trade with South America	8
The Cast-Steel Gun	8
Economy of English and American Railroads Compared	8
Statistics	8
Questions and Answers	8, 9
Manufactures	9
Machinists' Supplies and Iron	10

Trade With South America.

The fact that an American company has secured the contract for building and equipping 650 miles of railroad for the Government of Chili, ought to have a good deal of significance to manufacturers in this country, beyond what is involved in the contract. Building these roads means opening up a country to commerce, rich in mineral deposits, and inhabited by a people whose needs will grow rapidly under the civilizing influence of railroads.

In other South American States there is railroad building going on to some extent, and talk of extensive operations in that direction. These States are all rich in natural products and fertility of soil, and the importance of close commercial intercourse with them can, in the near future, hardly be over-estimated. Their people will be large buyers, because they will, from the development of the naturally rich country in which they live, have ample means with which to buy. They will produce many things needed in this country, and if manufacturers and merchants here improve their opportunities, they can supply them with quite as much in return.

It is natural that South American trade should be largely with the United States, but it will not come here without an effort to bring it about. The inhabitants of the South American States, now being opened up to commerce, have needs peculiar to their surroundings; if these needs are carefully studied, and reasonable effort made to meet them, valuable trade is sure to follow.

The Cast-Steel Gun.

There seems to be a good deal of misapprehension regarding the recent test of a cast-steel gun by the Navy Department, many persons seeming to take it for granted that, because this, the first gun of the kind, burst at the first service charge, it is thereby proven that a steel casting has not sufficient strength to make it available for large guns.

In reality, this gun test was not a test of the strength of the steel of which the gun was composed, and if that were the object, there are other and better ways of testing the strength of cast-steel. But it was a test of the practicability of making a gun of that size of a single casting, in such a way as to make the full strength of the material available in resisting the enormous pressure to which it must be subjected.

The wrought-steel, of which built-up guns are made, is not strong enough for the purpose, unless special means are employed to make the full strength of the entire thickness of the metal available and useful at the moment of discharge. This is done by shrinking or forcing, by hydraulic pressure, rings of steel onto the tube until the required thickness is obtained, all the rings being under initial tensile strain.

It has long been well understood that, beyond a certain point, no additional strength is obtained by increasing the thickness of cast-iron cylinders for hydraulic rams, because a sufficiently high pressure will strain the inner portions of the walls beyond the elastic limit of the metal, and produce a crack before the outer portions are subjected to any strain whatever, and, the pressure being maintained, the crack will extend to the outer surface, and the cylinder be destroyed.

The enormous pressures generated in the bore of a large gun will produce the same result, unless the outer portions of the gun can be made to resist the enlargement of the inner portions, and prevent its going beyond the elastic limit of the material.

In the case of the gun which burst, this was attempted to be done by cooling the gun in such a way as to make the outer portions exert the required pressure upon the inner portions. The failure of the gun simply proves that this is not so easily done as many supposed it would be, but does not prove that it is impossible.

It is said that the gun, after leaving the hands of the company which cast it, was subjected to some sort of a tempering process without their authority, and with a view to its improvement.

It is well known that any piece of metal, subjected to internal strains by shrinkage, is relieved of those strains by being brought to a red heat; and, if this was done, we should say that the unfitness of solid cast-steel as a material for large guns had by no means been proven by this failure.

Economy of English and American Railroads Compared.

At a late meeting of the American Society of Civil Engineers, Mr. Edward B. Dorsey read a paper in which the cost of transporting goods and passengers over American railroads was compared with the cost of the same in England.

Mr. Dorsey has made quite an extended and thorough investigation of the subject during a number of years, commencing with the idea of showing American engineers that it would pay better to adopt the English plan of building roads—build them in the best possible manner in order to save on operating expenses. But, to his astonishment, he discovered, as the investigation proceeded, that, although the English roads cost about five times as much per mile as American roads, the latter were being operated at much less expense per ton of freight hauled.

Mr. Dorsey showed the error of considering the English roads to be most economically operated, because the expense per train mile was less, and that, when allowance is made for the difference in the number of tons hauled, the advantage is very largely with the American roads. On the London & Northwestern, the average number of tons of freight hauled is 79, while on the Pennsylvania it is 207; the reasons given for this vast difference being:

Too light loads to the English train, the universal use on the American roads of rolling stock with bogie trucks, the use on the American roads of freight cars which carry a much greater percentage of paying load to the dead weight than the wagons used on the English roads, the great speed at which the English freight trains run, the use of light engines that cannot be repaired as cheaply as the American engines, and the custom of giving each shipper the right of a freight wagon, even for small quantities of goods.

All the data collected by Mr. Dorsey, during the five years of his investigation, go to show that the total cost per mile ton on American roads is less than half the cost on English roads, though the cost of transporting passengers is about the same in both countries.

Statistics.

The rage for statistics seems to gather force, and nowadays, when anyone wishes to show that a certain thing is or is not true, he does not open his eyes, look about him, and tell you what he sees, but he goes to statistics, and presents tables and diagrams, and long rows of dreary figures, to demonstrate that, no matter what your preconceived notions have been regarding things in general, they are all wrong.

If you have come to the conclusion after repeated experiments, that boiled cabbage is not suited to your digestive apparatus, that you don't like boiled cabbage anyhow, and haven't money enough to buy it if you did like it, you will find plenty of statistics and analyses to prove that you are utterly and hopelessly wrong about it; that boiled cabbage is not only the best thing you can possibly eat, but is relished by something over 100 per cent. of the human family, and last, but not least, that you are abundantly able to buy it, or anything else which statistics show that you ought to have.

One of the most brilliant examples of the use of statistics is going the rounds of the papers now, and is credited to the *Popular Science Monthly*. These figures are supposed to show the effect of regularity of habits, or of occupation upon length of life, and are called "very significant facts."

The method of procedure seems to have been to take 1,000 men, all over 75 years of age, and ascertain what their occupation had been, and then to conclude, and to ask a long-suffering public to believe, that the proportion of men engaged in any one occupation, who live to be over 75 years old, is indicated by the number found among the thousand old men taken promiscuously, who had followed that occupation.

Amongst the thousand old men, 461 were found who had been farmers, 92 carpenters, 70 merchants, 61 mariners, 49 laborers, 42 shoemakers, 41 manufacturers, 23 clergymen, 23 masons, 16 blacksmiths, 16 bankers, 12 each iron workers, mill hands, physicians and lawyers, and the balance are divided among nearly all the trades and professions, the list including only one each of the following: hermit, hunter, chemist, journalist, soldier, broker, auctioneer, jockey, and contractor.

Could anything be more foolish than to conclude that such figures are any indication whatever, as to the comparative healthfulness of the various occupations? A thousand men of any age whatever, say 21 years, could be taken promiscuously, and it is altogether probable that about the same proportion would be found in the various occupations. We should hardly expect to find amongst 1,000 men, 30 years old, as many bankers as merchants or manufacturers. Should we, therefore, conclude that banking was less healthy as an occupation than selling or manufacturing goods?

We should expect to find among 1,000 men 30 years old more farmers than contractors; and if we did, this statistician would ask us to believe that the relative chances of farmers and contractors living to 30 years of age would be in the same proportion.

By the same process of reasoning, if a greater number of these old men had been found to wear blue socks, than were found wearing green ones, it would have been demonstrated, not that more men wear blue socks than wear green ones, but that blue socks are more conducive to long life than green ones!

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(563) T. P., Indianapolis, Ind., writes: I would like to learn nickel-plating. I cannot find any information in books. Please give theory and method of doing it. *A.*—See answer to Question 539, in our issue of Dec. 15, 1888.

(564) Reader, Rome, N. Y., asks: What instrument or method is used to compute the pressure in ounces of a blower such as is used in blacksmith shops, etc.? *A.*—See AMERICAN MACHINIST, May 28, 1887, answer to Question 239.

(565) C. F. W. B., Scranton, Pa., asks: Will you please inform me of the proper chemicals used for making blue prints? I have tried several different forms, but with poor success. *A.*—See answer to Question 449, in our issue of Nov. 5, 1887.

(566) C. A. S., Lynn, Mass., writes: Will you please tell me if lampblack is a good wood-filler and preserver? It is often used in combination with other material, such as pattern makers' shellac. *A.*—We would not use it as a wood-filler. Pattern makers use it simply to give the shellac the desired color.

(567) O. A. T., ———, Mass., writes: I am building an engine; the cylinder is 2 inches diameter, stroke 4½ inches. What horse-power will this engine develop? And what weight should the fly wheel be? *A.*—We cannot answer your questions unless you state the steam pressure and speed of engine.

(568) J. J. W., Wahoo, Neb., asks: Over what height will a siphon take water? *A.*—In practice about 28 feet is the limit. 2. Are there any firms in this country which handle repairs for all kinds of sewing machines? *A.*—Yes. 3. Has a city board of engineers a right to examine and license a man to test and inspect boilers? *A.*—That depends upon the laws enacted in the locality.

(569) I., East Orange, N. J., asks: How thick should be the plates for a vacuum tank to resist a vacuum of thirteen pounds? *A.*—That depends upon the form and size of tank. 2. What should be the proportions of an air cylinder on a compressor to that of the steam cylinder? *A.*—That will depend on the steam and air pressure, and the general design of the machine.

(570) G. W., ——, asks: 1. What kind of vitriol is used for hardening steel, and how is it used? *A.*—Oil of vitriol, otherwise known as sulphuric acid. It is the same as used for pickling cast-iron. The piece to be hardened is heated, then cooled in the vitriol the same as in water. 2. Is there any liquid better than vitriol for making steel tough and hard? *A.*—For all ordinary purposes we prefer water.

(571) O. R. D., York, Pa., writes: Enclosed please find a piece of metal coated with tin. What I would like to know, if there is anything better than tin, which will give a more silvery appearance? Is there a white metal which could be used in place of tin, or something which might be mixed with the tin, so as to give it a better and smoother appearance? *A.*—We know of no other way of obtaining a better appearance than that obtained by tinning, except it is nickel-plating.

(572) E. M. W., Pittston, Pa., asks: Please give me the exact horse-power of an automatic engine 12"x14", running at 225 revolutions, boiler pressure, 60 pounds. *A.*—It would be impossible to tell what horse-power could be devoloped with such an engine. That would depend on the design and construction. But the rating of a steam engine should be with reference to the work it will do with good economy. If the engine is well designed and constructed, we should, at 60 pounds' boiler pressure, rate it at 50 indicated horse-power.

(573) W. H. C., Kearney, Neb., asks: How can I determine the duty of a pumping engine from the following data: Coal burned, 24,470 lbs.; gallons of water pumped, 2,890,000; average pressure, 30 lbs.; lift, 12 feet? *A.*—The duty of a pumping engine is the number of pounds of water raised one foot high for each 100 pounds of coal burned. We assume that the 30 pounds' pressure referred to is the pressure against which the pump piston works. This is equal to a head of $30 \div 4.33 = 69.3$ feet; add 12 feet (suction) to this, and the total head is 81.3 feet. The pounds of water are: $2{,}890{,}000 \times 8.33 = 24{,}073{,}700$. Then the duty is $\frac{24{,}073{,}700 \times 81.3}{(24{,}470 \div 100)} = 7{,}998{,}331$ foot pounds.

(574) "A," Springfield, Mass., asks: Will you inform me what mechanical process is required to freeze water by using ammonia, or sulphurous anhydride, and in what form is the ammonia used? *A.*—Ammonia is used in the form of ammoniacal gas, which is forced by a pump into a coil of pipe at a high pressure. This causes the gas to become heated, and this heat is carried off by running cold water over the outside of the pipes, when, if the pressure is sufficiently high, the gas is liquefied. It then passes out of this coil into one in which the pressure is quite low. This reduction of pressure is accompanied by a corresponding reduction of temperature, and thus the required low temperature is obtained. Sulphurous anhydride is used in the same manner, but the pressures used are much lower.

(575) D. D. D., Chicago, Ill., asks: Is the height of a chimney measured from the bottom of flue opening, or level of grate? *A.*—From the top of grate. 2. In a chimney 75 feet high, should the inner flue walls be carried up to 60 feet? And why would not 20 feet above flue opening be enough? *A.*—We should prefer to carry the flue wall up to 8 feet from the top of chimney. Practice seems to indicate that high flue walls give the best result. 3. In figuring the bearing abilities of beams accordto manufacturers' pocket-books of tables, what is the use of table of radius of gyration, or the square of radius of gyration? *A.*—These are important factors in finding the strength of beams. The tables are given for the purpose of saving labor. For the manner of applying the figures contained in these tables, we must refer you to books treating on the strength of material.

(576) J. C., Philadelphia, Pa., writes: I have a screw to cut, which is 2¾" pitch, and 2¾" diameter. We have a lead screw in our lathe, which is ¾" pitch. I would like to know if there is any way to figure the gears for such a lead screw? I can figure the gears for a screw having any number of threads per inch, but we have been trying different gears till we found the right ones. *A.*—There is a way of figuring the gears for this or any other possible combination. 2¾ = 11-4, and the gears on stud and screw will have the same proportion to each other that ¾ (the pitch of the lead screw) has to 11-4, the pitch of the screw to be cut, or they will be in the proportion of 3 to 11 with the smaller one on the screw, provided the stud runs at the same speed as the spindle, and the lathe is simple geared. Gears which are in the proportion of 3 to 11 are 24 and 88; 27 and 99; 30 and 110; 33 and 121; 36 and 132, etc. The gears for this are just the same as you would use if the lead screw had 11 threads per inch, and you wanted to cut 3 per inch.

(577) C. E. W., Oshkosh, Wis., writes: I would like to ask, is 15 square feet of heating surface sufficient per indicated horse-power in ordinary saw mill practice, where green refuse is used for fuel? The timber is fir and cedar. *A.*—Fifteen square feet of heating surface per indicated horse-power is sufficient; in fact, for the kind of fuel used, less heating surface would do; but, since saw mill boilers generally receive less care than any other boiler, we prefer the figures given. 2. A dealer proposes to sell me a boiler with 600 square feet of heating surface, to run a 12" x 16" engine, 500 feet piston speed, 100 pounds' boiler pressure, cutting off at ⅜ of the stroke. I think there ought to be at least 900 square feet of heating surface. What is good practice, and what class of boiler would you advise—tubular, or a two-flue boiler? *A.*—The power of your engine will probably not be less than 100 indicated horse-power. Consequently, at 15 square feet of heating surface per horse-power, you will need 1,500 square feet of heating surface, which shows that a boiler with 600 square feet is not large enough, and one with 900 square feet may require greater care than is generally bestowed on boilers in saw mills. As to the type of boilers, there is not much choice between the two you mention; we would prefer the two-flue boiler. 3. Is it customary in machine shops to pay more for overtime than for the regular hours, when, in case of a rush, they find it necessary to work overtime? *A.*—Yes, proprietors of first-class machine shops never expect their men to work overtime without increasing the pay per hour. 4. Can a firm in justice demand such over hours from men who don't wish to work more than the regular hours? *A.*—No; men have a right to use, as they please, their own time, after a regular day's work is done. But workmen are not devoid of common sense, and, if they find that their employer is in a tight place, and that overtime will help him out, they will cheerfully give up their leisure hours, and help him out of his difficulty.

(578) J. L., Brooklyn, N. Y., asks: What kind of material is aluminum? *A.*—It is the metallic base of alumina, which is the plastic principle of certain kinds of clay. The color of aluminum is white, inclining to blue; it is very malleable and ductile. Its specific gravity is only about 2.60; its melting point not less than 1,000° Fahrenheit. It is the most sonorous of all metals. One way to obtain it is as follows: Make a thick paste of alumina, powdered charcoal, sugar and oil, and heat it in a covered crucible until all the organic matter is destroyed; then transfer the product to a porcelain tube, and connect the one end with another tube containing dried chloride of calcium, and the other end with a small tubulated receiver. Then expose the porcelain tube to the heat of a small oblong furnace, and having connected the chloride of calcium tube with a vessel disengaging chlorine, pass the gas through the apparatus, at the same time raising the heat of the tube to redness. In one or two hours, or as soon as the tube becomes choked, the whole must be allowed to cool and be taken to pieces, and the sesquichloride of aluminum thus formed collected. Then place nine or ten pieces of potassium, of about the size of peas, in a platina crucible, and upon them an equal number of similar pieces of the sesquichloride of alumina formed as above; the cover is now to be put on and secured in its place with a wire, and the heat of a spirit lamp cautiously applied, until the spontaneous incandescence of the matter ceases. When cold, throw the crucible into a large vessel of cold water, agitate and collect the grey powder deposited, and again wash it well and dry it. This grey powder consists of small metallic scales, resembling platina. It is not acted on by cold water, but is dissolved by alkalies and some of the acids. Heated to redness, it catches fire and burns with great rapidity in the air, and in oxygen gas, with intense brilliancy. The powder, blown upon the flame of a candle, displays an immense number of inflamed points of great splendor. Another way of obtaining it is described in answer to Question 296, in our issue of July 16, 1888. 2. Where can I buy a small quantity? *A.*—From any dealer in the finer metals.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link Belting.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Bargain—Two Hammond Type-writers. W. Lewis, Corry, Pa.

The Best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Pattern letters and figures to place on patterns for castings. H. W. Knight & Son, Seneca Falls, N. Y.

"The Bulldozer." a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Dynamos, Engines, etc., need Common-sense oil filters; great saving. C. F. Baker, Minneapolis, Minn.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Mechanical drawing taught by correspondence. Thoroughly practical. I. Donald Boyer, Dayton, O.

Buy a first-class Arc Light. The Waterhouse Electric & Mfg. Co., Hartford, Conn., have it. Send for catalogue.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Automatic Wire Straightening and Cutting Machinery, Tools, etc. Manufactured by Collins-Gibbons Mfg. Co., St. Louis, Mo.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Upright drills, improved, sizes 21", 23", 25", 28" 32", 36" swing; finely made and great capacity. Currier & Snyder, Worcester, Mass.

Patents obtained. Patent litigation conducted. R. G. DuBois, Patent Attorney, 928-930 "F" street, Washington, D. C. Correspondence invited.

Send for Descriptive Catalogue of "Roper's Hand Books" for engineers and firemen. Edward Meeks, Publisher, 1012 Walnut street, Philadelphia, Pa.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N. Y. Send for des'n.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Dec. 1, p 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

See illustration of improvements in Hooks for Steam Engines, in Nov. 24 issue. For particulars address T. C. Dill Machine Co., 726 Girard av., Phila. Pa.

With my System, Exhaust Steam Heating costs nothing for fuel; Live Steam Apparatus altered to Exhaust. Satisfaction guaranteed. Geo. A. Barnard, 15 Cortlandt street, New York.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

A system of easy lettering, by J. H. Cromwell, giving 26 forms of alphabets. The space to be lettered being divided into squares; simple and effective. Price 50 cents. Catalogue of books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y

Special facilities for the manufacturing of all kinds of light machinery, hardware and novelties, by contract or otherwise. Presswork and stamping done on short notice. Estimates furnished. Punches, dies and special tools made when required. Rockaway Mfg. Co., 3 E. 14th street, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing" By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 29, 1886 issue, and up to and including Dec. 15, 1888 issue 65 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 80 articles have thus far appeared up to and including the Dec. 20, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

Boyd & Webster are building a large planing mill at Dallas, Texas.

The nail mills at Duncannon, Pa., recently burned, will be rebuilt.

The Portland Wrench and Tool Company is a new firm at Portland, Maine.

C. M. Hull is interested in building a cotton-seed oil mill at Rosedale, Miss.

S. Odenheimer is interested in building a bagging factory at New Orleans, La.

W. D. Medenhall will build a sash, door and blind factory at Greensboro, N. C.

The Frederick Seamless Hosiery Company will build a mill at Frederick, Md.

The sash and blind factory of C. Petty & Co., recently burned at Archdale, N. C., will be rebuilt.

The Harris Woolen Mills, at Woonsocket, R. I., which have for some time been shut down, are now running.

The Piedmont Manufacturing Company will increase the capital stock of their cotton mill at Piedmont, S. C.

The Richmond & Alleghany Railroad Company have purchased land at Gladstone, Va., upon which to build shops.

A plant for electric lights for a wing of the capitol at Washington will be established. About 3,000 lights will be required.

H. W. Bullard, Poughkeepsie, N. Y., is enlarging his works, and putting in new tools. He does general machine work, builds yacht engines, etc.

Wheeler & McKenney are building a wood-working mill at Phillips, Maine. The town exempts new manufacturing enterprises from taxation for ten years.

The Berkshire Woolen Company, of Great Barrington, Mass., which suspended operations a few months since, owing to financial difficulties, has resumed business.

The Aluminum Steel Company, Newport, Ky., are to erect a twenty-ton daily capacity aluminum open-hearth steel plant. Their process dispenses with the puddling furnace entirely, and the cast-steel is guaranteed to stand a tensile strain of 65,000 to 80,000 pounds per square inch, with 45 per cent. reduction of area.

The Denver (Colo.) Iron Works has a contract for furnishing the Chinese Government with a large order of hoisting and smelting machinery. The machinery is to be used on government property near Tien-tsin.

A. L. Ide & Son, Springfield, Ill., have issued a new catalogue of the Ide and the "Ideal" engines made by them; also feed-water heaters and steam pumps. The catalogue is very fully illustrated with perspective views and detail cuts.

The Minnesota Car Company, of Duluth, Minn., has been organized with a capital of $400,000. The works, which will consist of a rolling mill, machine shop, foundry and car works, will be constructed, in every respect, according to the most approved standard.

There is water-works agitation at Avon, Mass.; North Adams, Mass.; Sheffield, Ala.; Johnson City, Tenn.; Defiance, Ohio; Brantford, Ont.; Des Moines, Iowa; Los Angeles, Cal.; Pekin, Ill.; Greeley Center, Neb.; Swanton, Ohio; Lincoln, Neb.; Westerville, Ohio; East Randolph, N. Y.; Chehalis, W. T.

The Union Paper Mill Company, of Monongahela City, Pa., has made application for a charter. The company has purchased the old paper mill of Monongahela City, and will repair it at considerable expense. Complete new machinery will be put in and a new office building erected. The mill will give employment to seventy-five men.

Montgomery & Co., 105 Fulton street, New York, have issued a catalogue of small boilers for running model engines. This boiler appears to be safe, and excellent for the purpose, and is made so as to be sold cheap. The catalogue also contains illustrations and descriptions of small engines, which are sold complete, or the castings and parts are sold to those who desire to do the fitting up.

Plans and specifications have been drawn by the Edgar Thomson Steel Works Company, for the erection of an immense foundry and machine shop at Braddock, Pa. The intention of the Carnegie firm, in putting up this structure, is to make all their own castings, moulds and bell hoppers for the blast furnaces, etc., which work they have always been obliged to get done by outside firms. A 15-foot boring mill has been ordered for the machine shop. —*American Manufacturer.*

Sidney A. Grant of this city [Springfield, Mass.], who has long been known as an inventor of envelope-making machinery, and has his machines in England, Australia and other foreign countries, as well as in America, has completed and patented a new machine, which has several marked improvements over any yet made. It occupies but 24x35 inches on the floor, yet will do much more work and a greater variety than the old machines, and it requires but little power. The machine will gum, fold, print and emboss at once, and several colors may be used in both printing and embossing.—*Springfield Republican.*

W. F. Mattes, of the Lackawanna Lubricating Co., whose Lackawanna grease cup was illustrated in our December 15th issue, reports abundant orders for these cups. Mr. Mattes some weeks since resigned the position he has so long held as chief engineer of the Lackawanna Iron and Steel Co., of Scranton, Pa., and has accepted tempting offers made him to engage in a similar capacity with the West Superior Iron & Steel Co., of West Superior, Wis. He has a corps of draftsmen at work in his office at Scranton, preparing plans for the extensive blast furnace and pipe foundry plants now being built for this latter company, which also contemplates even more ambitious undertakings in the future.

A Cleveland (Ohio) dispatch says: Three-quarters of the large iron shipbuilding plant of the Globe Iron Works, on West River street, in this city, was destroyed by fire. The burned portion of the shipyard was 700 feet in length and 50 feet in width, and it contained $100,000 worth of valuable machinery. Besides the buildings and stock consumed by the fire, the office was gutted. Valuable models and drawings, the accumulation of years, were ruined. Four large steel vessels in process of construction were upon the stocks, within a few feet of the burning buildings, but the ships were saved from damage. The loss is approximately fixed at $200,000, and it is probably covered by insurance. One thousand workmen were employed in the shipyards, and they will resume their work immediately. The rebuilding of the plant will begin as soon as the insurance is adjusted.

The American Brake Company, St. Louis, Mo., have undertaken the improvement of their works on a large scale, and at an estimated cost of about $25,000, accounting for both additional machinery and new buildings. One of the new structures which they now have under way will be a substantial two-story brick, 65x75 feet, to contain the store room, boiler house and shipping room; and the other, 36x50 feet, will serve as an addition to the blacksmith shop. The new steam plant and machinery ordered by the company embrace the following, according to Superintendent Poor: 125 h. p. Babcock & Wilcox boiler, with the Verona automatic stoker; two new Westinghouse engines, one of 65 h. p. for the machine shop, and the other of 35 h. p. for the blacksmith shop; large steam hammers including a 1,500 pound Bement & Miles hammer; a drill press that will perform the remarkable feat of running two 4-inch twist drills at the same time through iron or steel; 6-spindle drill press; 2-inch bolt cutter; new furnaces, etc.—*Age of Steel.*

Machinists' Supplies and Iron.

New York, Dec. 15, 1888.

Iron—American Pig—Lehigh and North River brands, $18 to $19 for No. 1 X Foundry; No. 2 Foundry, $17 to $17.50.

Scotch Pig—Coltness, $21; Gartsherrie, $20.50; Summerlee, $21; Eglinton, $19 to $19.50.

Copper—17⅜c.

Tin—22¼c. to 22¼c.

Spelter—In small lots, 5c.

Lead—3.70c. to 3.75c.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—See bottom of third column, page 11.

Experimenter on lamps or novelties wants position; satisfaction guarant'd. Box 55, Am. Machinist.

Wanted—Pattern maker. Steady work. State experience, whether married, and give references. Studebaker Bros. Mfg. Co., South Bend, Ind.

Young man, thoroughly acquainted with automatic engine work, desires position as foreman of shop building light automatics. Box 548, Alliance, O.

Experienced toolmkr. and mach., competent to construct automatic dies and mach'y for sheet metal and other goods, wants position. Box 56, Am. Mach.

First-class draftsman wanted immediately on engine design. State experience, age, references and salary expected. Bucyrus Foundry & Manufacturing Company, Bucyrus, Ohio.

Wanted—An experienced salesman in the line of heavy machinery, to take charge of an established branch store. A permanent position for the right man. Address with references, R. S. Kendall, care of American Machinist.

Wanted—A capable draftsman, with experience in designing blowing engines and rolling mill engines; a young man having a collegiate education and some shop experience preferred. Address B., care of American Machinist.

Wanted—Foreman for Steam Pump Works. Must be competent to handle men, with a thorough system, and to get out work in Single and Duplex form rapidly and correctly. State age, wages and experience. Address Box 51, American Machinist.

Wanted.—A man thoroughly familiar with building of engine lathes, to take charge of 50 men on lathe work for same. Must be capable of handling men to good advantage and understand most improved methods of doing the work. Address, Box 57, American Machinist.

Wanted—A change by a young man, machinist and draftsman. Ten Years exp.; at present employed on U. Milling Machine and Cutter Grinder; accustomed to machine tool repairs, lathe or planer work; open to engagement after Saturday, Dec. 15. Address Box 53, American Machinist.

1889—Two mechanical engineers, having large experience in machinery and tools, commanding the English, French, German, Italian and Scandinavian languages, desire to represent an American firm at the Paris exhibition in '89; correspondence solicited. Address E. F. G., American Machinist.

Draftsman, young, good designer, with experience in large and small shops, quick mech'l judgment, good business ability—wants connection with small foundry and mach. shop, preferably in hands of young, enterprising man. Accept small salary and interest. References. 732 American Machinist.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent steel tube scrapers are unquestionably the best. Crescent Mfg. Co., Cleveland, Ohio.

Crescent boiler tube cutter, for setting new and removing old tubes. Crescent Mfg. Co. Cleveland, O.

Light and fine machinery to order; Foot Latne. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., consulting engineer for hydr. and pumping machinery, etc.

Punches, dies and special machinery built to order C. F. Langston & Co., 70 N. 4th St., Phila., Pa.

Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

Wanted.—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

A foundry and machine shop in the natural gas belt in Indiana for sale at a bargain, on easy terms; doing a good business; has a good specialty. Address P. O. Box 573, Wabash, Ind.

Business—Will furnish capital to build patent specialties or machinery. Forty thousand feet of floor space, with power, for rent. Jas. Aitchison, Winslow & Center streets, Cleveland, Ohio.

In stock and for sale, a large lot of new and second-hand engine lathes, iron planers, upright drills, shaping machines and other machine tools. Send for list and catalogue. Address Fitchburg Machine Works, manufacturers of metal working machinery, Fitchburg, Mass.

Not having the facilities for the manufacture of the larger sizes of our *Positive Blast Blower* (Pat. Aug., 1888), for which there is a large demand, we wish to make arrangements for their manufacture, control, and sale, under royalty, with some responsible and suitable manufacturer. Four small sizes we are now making, which are in very successful operation. It is the best and cheapest Positive Blast Blower in the market. Address or call on Gesswein Machine Co., 292 Graham st., Brooklyn, N. Y.

Foreclosure Sale—The valuable Patents on Refrigerating and Ice Machines belonging to W. H. Wood; also drawings and patterns for machines in successful operation, with formula for ammonia gases, etc. Apply Box 54, American Machinist.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

ESTABLISHED 1832

Combines the best elements essential in a first-class **Hammer.** Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the world.

BRADLEY'S HEATING FORGES.

ESTABLISHED 1832

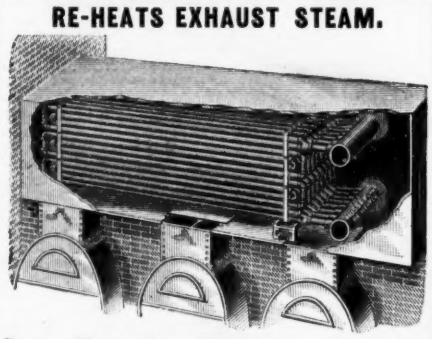
Pat. Aug. 30, 1887.

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements. **For hard coal or coke.** Indispensable in all shops to keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.

BRADLEY & CO.
SYRACUSE, N. Y.

98 Sudbury St., Boston, Mass.
63 Murray St., New York.

THE HUSSEY RE-HEATER
RE-HEATS EXHAUST STEAM.



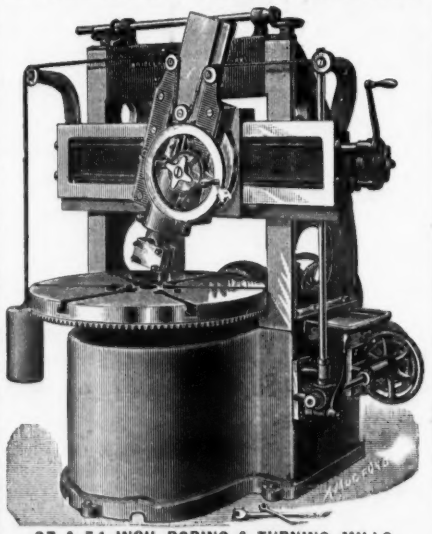
Super-Heats Live Steam, Heats Air or Water
WITHOUT COST.

The Hussey Re-Heater and Steam Plant Improvement Co.

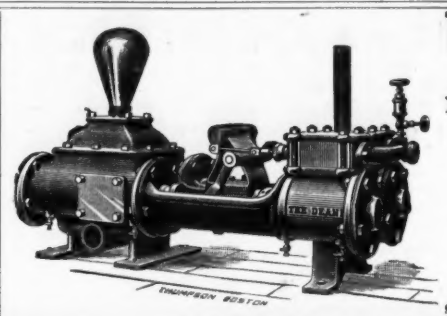
A. S. Hatch, President. S. D. Brewer, Gen'l Manager. 15 Cortlandt St., N. Y.

TANITE EMERY WHEELS and GRINDING MACHINES
FOR SAW MILLS, FOUNDRIES AND MACHINE SHOPS
For Circulars address
THE TANITE COMPANY, STROUDSBURG, MONROE CO., PA.
Or H. A. ROGERS, 19 John St., N. Y.

Bridgeport Machine Tool Works,
E. P. BULLARD, Prop.
BRIDGEPORT, CONN.



37 & 51 INCH BORING & TURNING MILLS, LATHES, SCREW MACHINES, TURRET MACHINES, &c.



THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.,
New York, Boston, Chicago, Philadelphia St. Louis,
Manufacturers of
STEAM and POWER
PUMPS
FOR ALL PURPOSES.
SEND FOR CATALOGUE.

SHAPERS.

The Hendey Shapers are generally acknowledged to have more special features required in a Shaper than any other in the market. All efforts by unfair opponents to decry their merits have simply resulted in increasing their sale. To-day they are more popular than ever. They are also better than ever. Write us for Catalogue and Price.

Shapers, Planers, Engine Lathes, &c.
THE HENDEY MACHINE CO., TORRINGTON, CONN.

IT PAYS TO USE THE BEST.

That is why **CRESCENT EXTRA STEEL** is found in so many well managed shops where results are closely watched.

For general machine shop tools and dies it is the most satisfactory steel you can get anywhere.

MILLER, METCALF & PARKIN,
CHICAGO, ILLS. PITTSBURGH, PA. NEW YORK, N. Y.

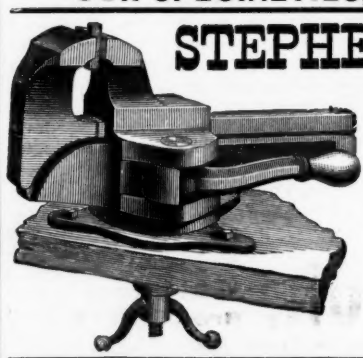
Sebastian, May & Co.'s Improved Screw Cutting
FOOT AND POWER **LATHES**

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.

167 West Second Street, CINCINNATI, O.

OUR SPECIALTIES, 8, 12, 14 and 18 inch Lathes.

STEPHENS' PATENT VISES.



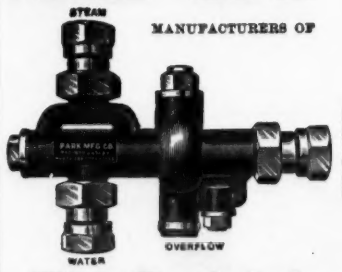
QUICK-ADJUSTING CAM AND TOGGLE JOINT.
Stationary or Patent Swivel Bases.
INCOMPARABLE FOR STRENGTH, DURABILITY FIRM HOLD AND QUICK WORK.
Has improved Taper, Pipe and other attachments. Made in 2, 2¾, 3½, 4½, 5½, and 6½ inch width of jaw.
Sold by the Trade. Send for Circular.

TOWER & LYON, MFR'S,
95 CHAMBERS ST., NEW YORK.

HENRY CAREY BAIRD & CO.,
Industrial Publishers, Booksellers and Importers,
810 Walnut St., Philadelphia.

☞ Our New and Revised Catalogue of Practical and Scientific Books, 80 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

PARK MFG. CO.

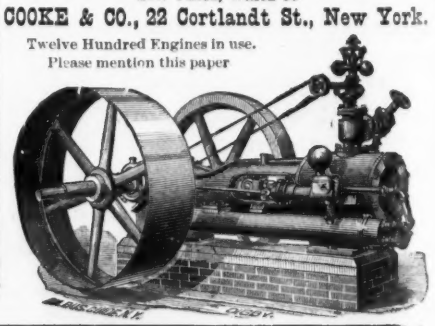


MANUFACTURERS OF
34 Beach Street, Boston, Mass.
The Park Injector,
EJECTORS AND JET APPARATUS.

"Star" Foot Lathe Swings 9x25 in.
LATHE Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers.
LATHE Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y

ERNEST W. NAYLOR,
CONSULTING ENGINEER, 149 B'way, N. Y.
Designer of hand, steam, power, and hydraulic jib cranes; square shaft, rope, hand and hydraulic traveling cranes. 20 years best English experience.

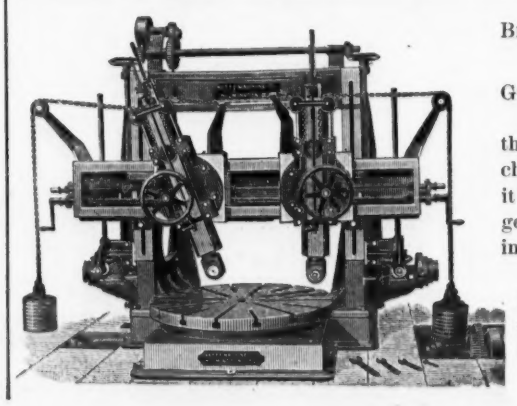
IF YOU WANT A STRONG, ECONOMICAL
ENGINE
EITHER HORIZONTAL OR VERTICAL,
For Steady Every Day and All Night Service and at a Low Price, Write to
COOKE & CO., 22 Cortlandt St., New York.
Twelve Hundred Engines in use.
Please mention this paper



FOR SALE, CORLISS ENGINES.
The Fishkill Landing Machine Co., located at **Fishkill, on the Hudson, N. Y.** offer to manufacturers and others desiring a well built, economical and durable engine, their improved **CORLISS ENGINES.** They are endorsed by many reputable engineers and persons using them. Address as above.

GEO. F. BLAKE MANF'G CO.
BUILDERS OF EVERY VARIETY OF

95 & 97 LIBERTY ST., NEW YORK. 111 FEDERAL ST., BOSTON.
WATER WORKS PUMPING **ENGINES A SPECIALTY**



Pittsburgh, Pa., Apr. 20th, 1888.

Betts Machine Co.,
Wilmington, Del.

Gentlemen:—

In reply to your inquiry concerning the 7 foot Boring and Turning Mill purchased from you, would say that I find it as near perfect as you possibly could get it. Although being rigid and strong in its construction, it is easily adjusted.

I have bored and turned pulleys 12 ft. diameter, and 26 in. face, with ease. In short, I consider it one of the best tools in the market.

Yours very truly,
Wharton McKnight.

NICHOLSON FILE COMPANY,

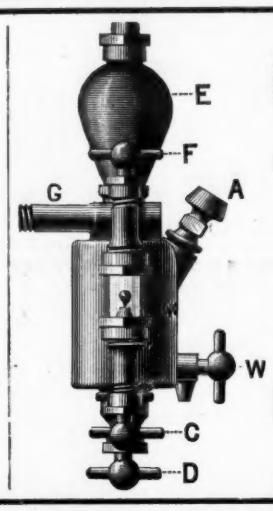
PROVIDENCE, R. I.

Files and Rasps,

OF EVERY VARIETY, INCLUDING THEIR

TRADE
EXTRA [X.F.] FINE.
MARK.

FOR FINE TOOL MAKERS, JEWELERS, SILVERSMITHS, WATCHMAKERS, ETC.



THE "VOLUNTEER"
UP-DROP, SIGHT FEED, LUBRICATOR,

(GATES PATENT.)

FOR STATIONARY ENGINES AND PUMPS OF ALL KINDS. LUBRICATORS FOR SINGLE OR DOUBLE CONNECTION.

PRICE LIST.

Nos.	1	2	3
Price	$10.00	$12.00	$15.00
Capacity	⅓ pt.	½ pt.	¾ pt.

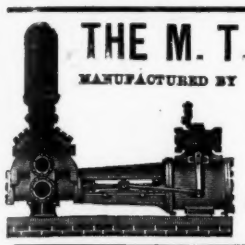
NATHAN MANUFACTURING CO.,
92 & 94 LIBERTY STREET, NEW YORK,

Send for Catalogue. SOLE MANUFACTURERS.

Established in 1874.

CLEVELAND TWIST DRILL CO.

Corner Lake & Kirtland Sts., Cleveland, O.
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.



THE M. T. DAVIDSON IMPROVED STEAM PUMP

MANUFACTURED BY

DAVIDSON STEAM PUMP COMPANY.

WARRANTED THE **BEST PUMP** MADE FOR ALL SITUATIONS.

PRINCIPAL OFFICE, No. 77 LIBERTY STREET, N. Y
NEW ENGLAND OFFICE, 51 OLIVER STREET, BOSTON, MASS.

GUILD & GARRISON,

Kent Ave. and South 10th St., Brooklyn, N. Y.

Builders of Steam Pumps, Vacuum Pumps, Vacuum Apparatus, Filter-press Pumps, Air Compressors, Condensers for Pans, Engines, Steam Pumps, Etc.

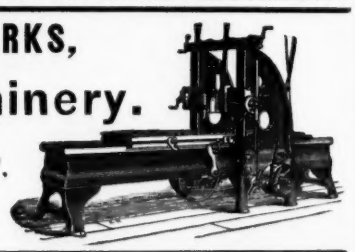
FITCHBURG MACHINE WORKS,

Manufacturers of

Metal-Working Machinery.

OFFICE AND WORKS

NOS. 13 to 21 MAIN STREET.
FITCHBURG, MASS.



SEND FOR CATALOGUE E.

IRWIN VEEDER,

Expert and Solicitor of Patents.

SIX years' practical experience in shops after receiving a technical education and before entering the practice.

Rooms 309-11, 225 Dearborn Street, Chicago.

J. H. RAYMOND, OF COUNSEL.

Root's Force Blast Rotary Blower.

FOR

FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.

SLOW SPEED, POSITIVE BLAST, PERFECTLY BALANCED.

Best Mechanical Construction.

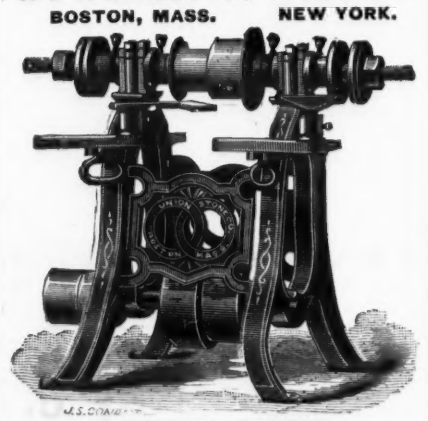
P. H. & F. M. ROOTS, Manufacturers,
CONNERSVILLE, IND.

S. S. TOWNSEND, Gen. Agt. } 22 Cortlandt St.,
COOKE & CO., Selling Agts. } NEW YORK.

In Writing, Please Mention This Paper.

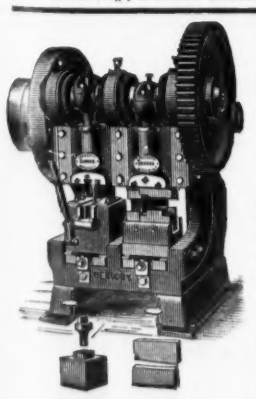
UNION STONE COMPANY,

38 & 40 HAWLEY ST., BOSTON, MASS. 36 JOHN ST., NEW YORK.



D. GRINDING MACHINE.

1¼ in. Steel Arbor. Takes Emery or Corundum Wheels to 20" diameter. Of this style we have six sizes, to suit different classes of work, from ¾" to 2¼" Arbor.



BEAUDRY'S DUPLEX Power Press

COMBINING PRESS, SHEARS AND PUNCH.

BEAUDRY & CO.

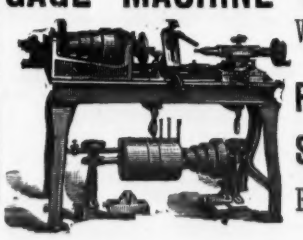
(Formerly of Beaudry's Upright Power Hammer.)

Sole Manufacturers.

Also manufacturers of HARD COAL HEATING FORGES.

Room 4, MASON B'DG,
70 KILBY ST.,
Boston, Mass.

GAGE MACHINE WORKS,



Waterford, N. Y.

Manuf'r's of

FOX, TURRET AND SpeedLathes AND Brass Finishers' TOOLS.

LECOUNT'S

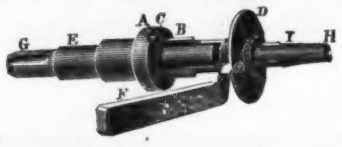
NEW EXPANDING MANDREL.

Amateur's Size.

Taking anything from ⅛ to 1 inch inclusive.

Price,.....$5.00

Patented Dec. 25, 1877.

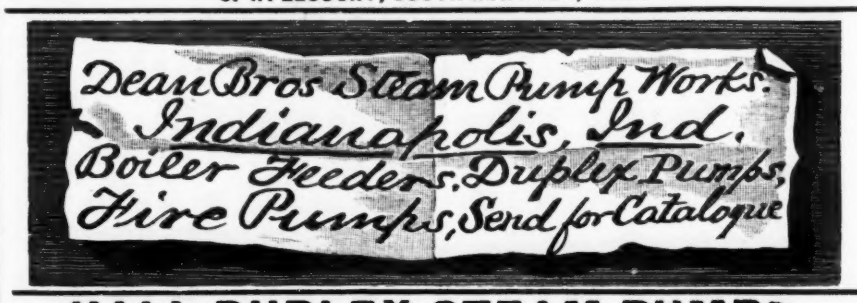


Machinist's Size.

No.			Price
1	⅛	to 1 in.	$10
2	1	" 1½ "	14
3	1½	" 2 "	18
4 (with screws)	2	" 3 "	32
5 "	3	" 4 "	44

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.

C. W. LECOUNT, SOUTH NORWALK, CONN.

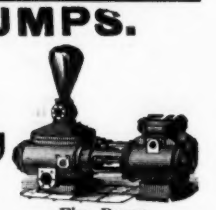


HALL DUPLEX STEAM PUMPS.

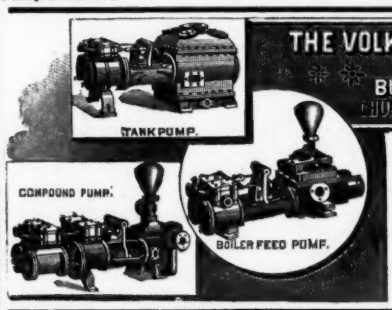
Send for New Catalogue.

Boiler and Pump Combined.

HALL STEAM PUMP CO.,
91 Liberty St., New York.



Fire Pump.



THE VOLKER & FELTHOUSEN M'F'G. CO.
MANUFACTURERS OF
BUFFALO DUPLEX STEAM PUMPS.

For Sale at Factory Prices by

A. Aller, New York; Walworth Construction and Supply Co., Boston; Henry I. Snell, Philadelphia; Thos. J. Bell & Co., Cincinnati; Shaw, Kendall & Co., Toledo; The George Worthington Co., Cleveland; Goulds & Austin, Chicago; Kennedy & Pierce Machinery Co., Denver, Col.; Sheriff & Ashworth, Pittsburgh, Pa.; Jos. Baur, Manistee, Mich.; Jas. Jenks, Detroit; Wickes Bros., East Saginaw; Adolph Leitelt, Grand Rapids; E. F. Osborne & Co., St. Paul, Minn.; Rundle, Spence & Co., Milwaukee; Joshua Hendy Machine Works, San Francisco; Flynn & Emrich, Baltimore; Forbes, Liddell & Co., Montgomery, Ala.; Bailey & Lebby, Charleston, S. C.; Pond Engineering Co., St. Louis and Kansas City; O. R. Goodwin, Norfolk, Va.; Columbus Supply Co., Columbus, O.; C. S. Leeds & Co., Minneapolis; H. D. Coleman, New Orleans.

HOWE, BROWN & CO., Limited,

ESTABLISHED 1859.

Formerly HUSSEY, HOWE & CO., Limited.

PITTSBURGH, PA.

Manufacturers of all kinds

CRUCIBLE AND OPEN HEARTH STEEL, CAMERON SELF-HARDENING STEEL,

For Shearing Tools and Turning Steel Tires.

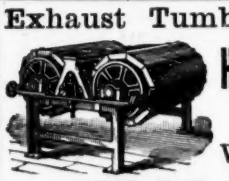
BRANCH OFFICES: Boston, 127 Oliver St. New York, 12 Cliff St. Chicago, 171 La Salle St.

DELAFIELD'S PAT. SAW CLAMP

With Saw for Cutting Metals. Saves all the broken hack saw blades. In use over two years, in all parts of the country. The new Clamps have the edges beveled that hold the saw. Free by mail for 50 cents. Extra blades, 1-2 in. wide, 7c. each. 70c. per doz; 1 in. wide, Stubs, 35c. each. Free by mail.

NOROTON MFG. WORKS, NOROTON, CONN.

Exhaust Tumbling Barrels.



Henderson Bros.

MANUFACTURERS,

WATERBURY, CT.

SEND FOR CIRCULAR.

FORGING AND WELDING BY PETROLEUM AIR BLAST FIRES.

GREAT ECONOMY OVER COAL. SCALING AVOIDED.

Wear of DIES lessened, and better work produced. Insurance not increased. No ASHES or CLINKERS. Continuous fire the whole day. Correspondence solicited.

AERATED FUEL CO., - Springfield, Mass.

J. H. BULLARD, Gen'l Manager.

ALDEN SPEARE'S SONS & CO., Boston, Mass., Agents for Eastern part of New England.

HARRIS & COWDERY, Ashtabula, Ohio, Agents for Ohio.

TO

CIVIL, MECHANICAL & MINING ENGINEERS,

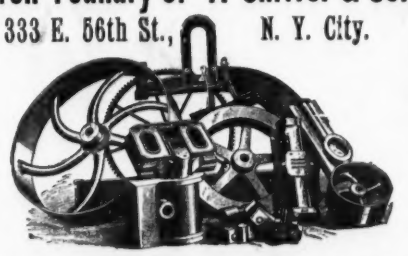
ARCHITECTS, BUILDERS, MANUFACTURERS, &c., &c.

Our COMPLETE CATALOGUE of SCIENTIFIC and INDUSTRIAL WORKS will be sent FREE by Mail on application.

JOHN WILEY & SONS, Astor Place,
NEW YORK.

Iron Foundry of T. Shriver & Co.,

333 E. 56th St., N. Y. City.



Nice Castings, Smooth and True to Patterns, of very best brands of Pig Iron.

CASTINGS IN QUANTITY AT FAVORABLE PRICES.

BEST PLANE IN THE WORLD.

The Gage Tool Co.'s Self-Setting Plane.

NEW YORK TRADE SCHOOLS,
68TH STREET AND 1ST AVE.

To GAGE TOOL CO., Vineland, N. J.

DEAR SIRS:—I have used the Planes made by your Company, and like them better than any Plane I have ever used.

Yours Resp'y, JAMES DEKAY,
Manager N. Y. T. Schools.

PHILA., PA., April 5th, '88.

GAGE TOOL CO., Vineland, N. J.

Your Plane is the most perfect Plane I ever used. I have been in the business for 40 years and have never found its equal. I could have sold it for double what I paid for it.

C. R. PALMER, 715 N. Broad St.

ASK DEALERS FOR THEM.

DRAFTSMEN!

If your Stationer does not keep Dixon's American Graphite Artists' Pencils, send 16 cents (mention this paper) and you will receive samples worth double the money.

DIXON'S GRADE STAMPS ARE AS FOLLOWS:

Similar grade to European Stamp of

Preferred by many draftsmen to the best imported.

V V S	—Very, very soft...	(B B B)
V S	—Very soft.....	(B B)
S	—Soft.....	(B and No. 1.)
S M	—Soft medium....	(H B and No. 2.)
M	—Medium black...	(F)
M	—Medium.....	(H and No. 3.)
M H	—Medium hard...	(H H)
H	—Hard.....	(H H H and No. 4.)
V H	—Very Hard.....	(H H H H and No. 5.)
V V H	—Very, very hard	(H H H H H H)

JOS. DIXON CRUCIBLE CO.,
JERSEY CITY, N. J.

WORTHINGTON PUMPING MACHINERY

HENRY R. WORTHINGTON,

NEW YORK,
BOSTON PHILADELPHIA
CHICAGO ST LOUIS SAN FRANCISCO

SEND FOR Illustrated Catalogue.

HARRISON SAFETY BOILERS have been manufactured in the United States since 1863.

That many of the oldest boilers are still in use, that the manufacture is still actively carried on, and that the demand for them from discriminating steam users is annually increasing, form suggestive facts. For full particulars and estimates, address

HARRISON SAFETY BOILER WORKS,
Germantown Junction, Philadelphia, Pa.

"STEAM"

A VALUABLE BOOK FOR EVERY STEAM USER AND ENGINEER.

PUBLISHED FOR FREE DISTRIBUTION, BY

THE BABCOCK & WILCOX COMPANY,

MANUFACTURERS OF

WATER-TUBE BOILERS,

107 Hope St., Glasgow. 30 Cortlandt St., N.Y.

THOS. H. DALLETT & CO.
1305 Buttonwood Street,
PHILADELPHIA, PA.
Portable Drills,
Hand Drills,
Boiler Shell Drills.
Light Drill Presses,
Special Machinery.
SEND FOR CATALOGUE.

This System of Feed Water Heater is the Best

AND THE

LOWE

is the simplest

HEATER

on the system.

Has Straight Tubes
With reliable provision for expansion, and will

HEAT AND PURIFY THE WATER.

EQUAL TO ANY
With same Feet of Heating Surface and

Wear the Longest

Send for description and Histories of Boilers and Feed Water Heaters, to

Bridgeport Boiler Works,
Bridgeport, Conn.

Agents, THE POND ENGINEERING COMPANY,
St. Louis and Kansas City, Mo.

Steam Boilers

FOR ALL PURPOSES,

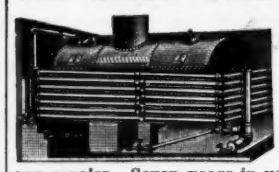
POND ENGINEERING CO.

St. Louis, Mo.

SEND FOR CIRCULAR.

L. S. STARRETT,
Manufacturer of
FINE TOOLS,
ATHOL, MASS.
SEND FOR FULL LIST.

THE SLOANE STEAM GENERATOR.



Saves 25 to 33 per cent. of fuel. Makes 50 per cent. more steam.

Attached to old or new boilers in two days, without disturbing walls. Do not require any repairs. Seven years in use. For particulars address,

G. W. SLOANE,
53 GREENPOINT AVE., Brooklyn, N. Y.

PATENT OILERS, CYLINDER SIGHT FEED CUPS.
Government Regulation
POP SAFETY VALVES,
For Stationary, Marine and Locomotive Boilers.
J. E. LONERGAN & CO., BRASS FOUNDERS AND FINISHERS,
211 Race Street, Philadelphia, Pa.
1888 CATALOGUE FREE ON APPLICATION.

WM. BERKEFELD'S FOSSIL MEAL COMPOSITION.

THE BEST
Non-Conducting Covering for
Steam Pipe and Boilers.

The only genuine Fossil Meal. Sold in bags of 110 lbs. each. Beware of imitations. Send for circulars.

Fossil Meal Co., 48 Cedar St., N. Y.
A. GIESE. Sole Proprietor.

MACHINE TOOLS.

Special or General, any size, for the manufacture of Ordnance, Locomotive, Marine and Stationary Engines, Ships' Boilers, &c., supplied to many leading Firms in the United States of America.

Asquith's Patent Radial Drills

Unequaled by any in the World. Send specification of requirements. Large Stock of Tools ready for delivery.

W. ASQUITH, HALIFAX, England

Patent CALCULATOR, For Engineers.

Mechanical.
Marine.
Electrical.
Mining.
Hydraulic.
Heating.
Sanitary.
Military.

Naval Constructors
Architects.
Builders.
Mechanics.
Assayers.
Chemists.
Scientists.
Students.

Size 10x3¼x1½ in. Complete pocket book. All practical problems solved at sight. Mailed on receipt of 75 cents.

R. C. SMITH, No. 1 Broadway, N. Y.

SEND FOR CATALOGUE.

WORCESTER MACHINE SCREW CO.

Manufacturers of Set, Cap and Machine Screws, Studs, etc.

Fit up your Boiler Shops, Bridge Works, Ship Yards, &c., with my "NEW" Standard

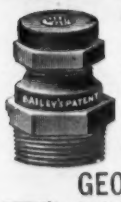
PUNCHES.

They will save you time and money.

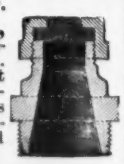
I. P. RICHARDS, PROVIDENCE, R.I.

BAILEY'S PATENT COPPER CAP FUSIBLE PLUG.

A Cheap Means for Preventing Accidents to Steam Boilers through Low Water.



The **fusible metal is kept from contact with the water,** avoiding the chemical and mechanical action, which would otherwise prevent it from melting. Cap is readily removable, permitting free inspection. Highly recommended by the chief Boiler Insurance Companies of Great Britain, over 150,000 being sold in Europe since first introduced, with increasing sales. Also by the U. S. Board of Supervising Inspectors of Vessels at Washington; by Prof. R. H. Thurston, and many other eminent expert engineers, also railway master mechanics, as superior to any now in use, and filling all requirements.



GEO. VAN WAGENEN, Sole American Licensee and Manufacturer.
Illustrated Pamphlets on Application. 233 West Street, New York City.

WESTCOTT CHUCK CO., Formerly Oneida Steam Engine & Foundry Co., **ONEIDA, N. Y.**

Manufacturers of all kinds of Lathe and Drill

CHUCKS

SEND FOR **Catalogue.**

Scroll Chuck. Jaws reversible. Diameter.	Capacity.	Combination 3 or 4 Jawed. Jaws reversible. Diameter.	Capacity.
4 9-16 in.	5 1-2 in.		
7 1-2 in.	8 in.		
10 1-8 in.	12 in.		
13 1-4 in.	16 in.		
16 in.	18 in.		
18 1-2 in.	21 1-2 in.		
21 1-4 in.	26 in.		
24 in.	30 in.		
30 in.	36 in.		
36 in.	43 in.		

WESTCOTT'S PATENT

Hydrostatic Machinery

PRESSES,
PUMPS,
PUNCHES,

ACCUMULATORS,

JACKS,
VALVES,
FITTINGS,

Vault Elevators, &c., &c.

WATSON & STILLMAN,
204-210 E. 43d St., New York.

CHUCKS

WRITE US FOR PRICES.

THE HOGGSON & PETTIS MFG. CO.
Est. 1849. NEW HAVEN, CONN.

PEQUOT DRILL CHUCK.

A new Drill Chuck having a more powerful grip than any chuck ever offered. This seems a broad claim, but we prove it to mechanics who will examine. Ask at your dealers or write us for particulars.

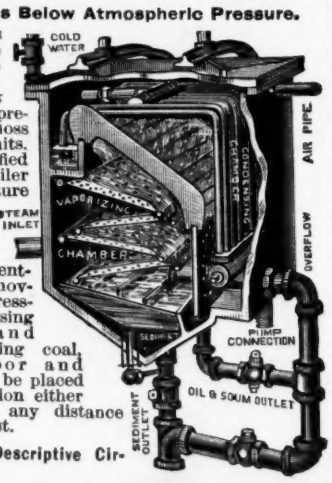
THE D. E. WHITON MACHINE CO.
NEW LONDON, CONN.

—WEBSTER'S—

"Vacuum" Feed-Water Heater and Purifier.

Operates Below Atmospheric Pressure.

Converts water to be purified into vapor and thence back into water, preventing any loss of heat units. Feeds purified water to boiler at temperature at or just below point of vaporization, preventing scale, removing back pressure, increasing power and steam, saving coal, water, labor and space. Can be placed in any position either near or at any distance from exhaust.



Send for Descriptive Circular.

WARREN WEBSTER & CO., MFR'S.
491 N. THIRD ST., PHILADELPHIA, PA.

VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches and Elevators,
PROVIDENCE, R. I.

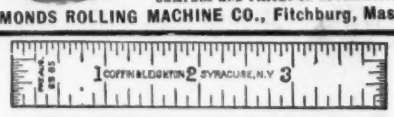
SIMONDS ROLLING MACHINE CO.,
MANUFACTURERS OF ROLLED FORGED SPECIALTIES,
INCLUDING
STEEL BALLS

For Anti-Friction Bearings, of Best Cast Steel, Hardened, Ground and Burnished, from 3-16 in. to 2 in. diameter.

In quality and density of metal, in uniformity of temper, and in accuracy and nicety of finish warranted unequaled.

SAMPLES AND PRICES ON APPLICATION.

SIMONDS ROLLING MACHINE CO., Fitchburg, Mass.



MACHINIST'S SCALES,
PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS

JAS. HUNTER & SON,
North Adams, Mass.

HEAVY UNIVERSAL MILLING MACHINE.

For variety and range of work this Machine has no equal, and for workmanship it has no superior.

All adjustments have Micrometer dials. Automatic feeds in all directions. Size of Main Journal, 3½"x6". Smaller size built.

PEDRICK & AYER, 1025 Hamilton Street, Philadelphia, Pa.

TRADE MARK.

HORTON LATHE CHUCK!

Manufactured by

THE E. HORTON & SON CO.,
Windsor Locks, Conn., U. S. A.
Send for Illustrated Catalogue.

A NEW CATALOGUE OF

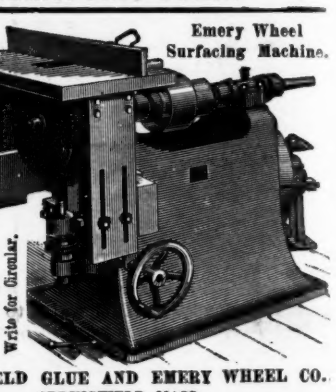
CUSHMAN CHUCKS

JUST ISSUED.

Containing new designs. Sizes and prices sent free on application to the

CUSHMAN CHUCK CO.,
HARTFORD, CONN.

Emery Wheel Surfacing Machine.



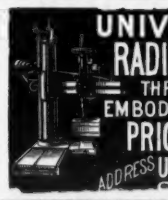
Base of machine has ample floor foundation. Table is so supported, that it cannot spring under heavy weights. Solid emery wheels or wheels covered with wood, and table is easily adjusted to wearing away of wheel. Write for Circular.

SPRINGFIELD GLUE AND EMERY WHEEL CO.
SPRINGFIELD, MASS.

SHAPING MACHINES

FOR HAND AND POWER.
6", 8" and 10" Stroke.
Adapted to All Classes of Work to their Capacity.
Circulars Furnished.

BOYNTON & PLUMMER,
WORCESTER, MASS.



UNIVERSAL RADIAL
RADIAL DRILLING MACHINES
THREE DESIGNS. SIX SIZES.
EMBODY ALL DESIRABLE FEATURES
PRICES $450.00 & UPWARD
ADDRESS UNIVERSAL RADIAL DRILL CO
CINCINNATI, O. U.S.A.

SCROLL SAWS

THE

FLEETWOOD & DEXTER

ARE THE BEST.

THOUSANDS SOLD.

Write for Illustrated Price Lists to

TRUMP BROS. MACH. CO.
Manufacturers.
WILMINGTON, DEL., U. S. A.

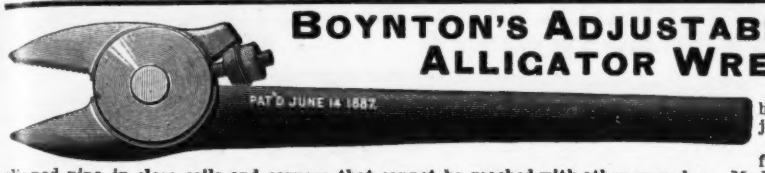
MORSE TWIST DRILL AND MACHINE COMPANY, New Bedford, Mass.

Manufacturers of Morse Patent Straight-Lip Increase Twist Drills.

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills

DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

BOYNTON'S ADJUSTABLE ALLIGATOR WRENCH.



Quick and handy in adjustment. Invaluable for work on clipped pipe, in close coils and corners that cannot be reached with other wrenches. Made entirely of drop forged steel. Six sizes. Manufactured by

CAMPBELL PRINTING PRESS AND MFG. CO.
160 WILLIAM ST., NEW YORK. 325 DEARBORN ST., CHICAGO.

CURTIS & CURTIS,

Successors to FORBES & CURTIS,
66 JOHN ST., Bridgeport Ct., U.S.A.
MANUFACTURERS OF
The Forbes Pat. Die Stock,
Pipe Cutting and Threading Machine, etc.

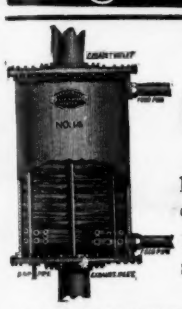
A portable cutting and threading machine with which one man can with ease thread pipe up to six inch diam. No vise is required.
Send for Illustrated Catalogue

HUGO BILGRAM,

440 N. 12th St., Phila., Pa.
Maker of all kinds of
MACHINERY.
Special facilities for Accurate Work.

Bevel Gears cut theoretically Correct.

ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills and Milling Machines. Agents, MANNING, MAXWELL & MOORE, 111 LIBERTY STREET, NEW YORK.



THE NATIONAL Feed-Water HEATER.

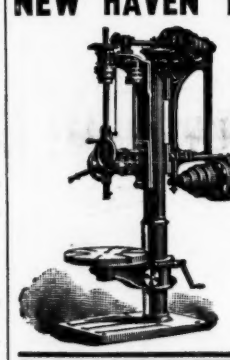
A brass coil Heater delivering water to the boiler at 210° Fahrenheit.

100,000 Horse Power sold. Prices Low. Satisfaction universal.

THE NATIONAL PIPE BENDING CO.,
82 River Street, NEW HAVEN, CONN.

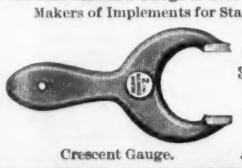
NEW HAVEN MANUF'G CO.,

New Haven, Conn.



Lathes, Planers, Shapers, Slotters, Etc.

American Standard Gauge & Tool Works, Wilmington, Del.
Makers of Implements for Standard Measurements.

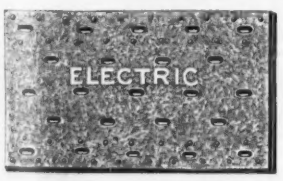


Over 35,000 in Use.

Crescent Gauge. Flat Bar Gauge. JAS. A. TAYLOR & CO.

DRILL PRESSES.
BICYCLES.
STERLING ELLIOTT
Newton, Mass.
TAP DRILL GUAGES.
CUTTING-OFF MACHINES.

ELECTRIC PERFORATED LEATHER BELTING!!



Prevents AIR Cushions.
Guaranteed for DYNAMOS

Pat. May 24th, 1888.

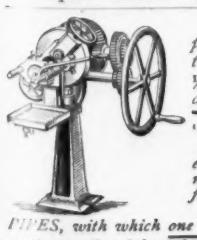
CHAS. A. SCHIEREN & CO.,
(MANUFACTURERS.)
CHICAGO. PHILA. NEW YORK. BOSTON.

McMAHON & COMPANY,

MANUFACTURERS OF

Machinists' Tools,
AND
Patent Friction Pulleys,
Water St., Corner Ledge,
WORCESTER, - - MASS.

"Eclipse" Hand Pipe-Cutting Machines.



No. 1.—Powerful, inexpensive, simple in construction. Cuts and screws pipes ¼ to 2-inch. Easily carried about.

"ECLIPSE" Nos. 2 and 3. These are powerful and most efficient machines for cutting large PIPES, with which one man can easily cut off and thread 6-inch pipe.
No. 2 Cuts and Screws 2½ to 4 in.
No. 3 " " 2½ to 6 in.
It will pay you to write us for particulars.

PANCOAST & MAULE,
(Mention this paper.) Philadelphia.
We also build Power Machines.

CARY & MOEN CO.
STEEL WIRE OF EVERY DESCRIPTION & STEEL SPRINGS.
234 W. 29 ST. NEW YORK CITY

Sterling Emery Wheel Co.,

Factory, West Sterling, Mas
Office, 17 Dey Street, New York.

Our Wheels for Machine Shop Work and Tool Grinding Superior to all others.

Send for Catalogue just published.

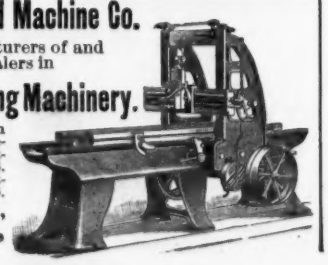
Chicago Office, 41 South Canal St., Chicago, Ill.

W. C. YOUNG & CO., Worcester, Mass.

Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, ETC.

L. W. Pond Machine Co.

Manufacturers of and Dealers in
Iron Working Machinery.



Improved Iron Planers a specialty. Feed, patented Feb. 9, 1886. Belt Shifter, patented Nov. 2, 1886.
140 Union St., Worcester, Mass.

D. SAUNDERS' SONS, Yonkers, N.Y.

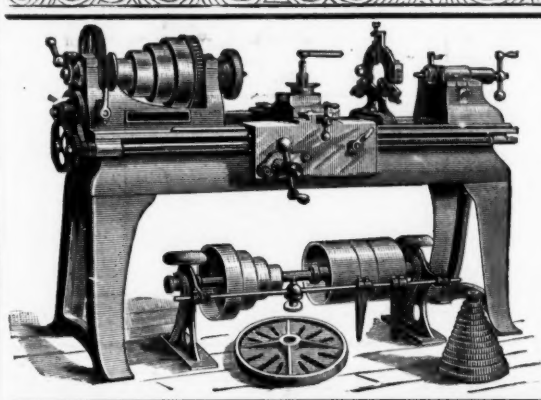
Steam & Gas Fitters' Hand Tools.
SEND FOR CIRCULAR.

MANUFACTURERS OF
Pipe Cutting, THREADING, AND Tapping Machines.

THE PATENT WHEEL PIPE CUTTER shown in the cut combines simplicity with strength and lightness. Easily adapted to various sizes of pipe. Rolling instead of sliding motion. No loose parts to become detached and mislaid. All wearing surfaces are of tool steel hardened. Less friction of parts than any other pipe-cutter made.

BUFFALO FORGES

BLOWERS, EXHAUSTERS, HEATING FURNACES. HAND BLOWERS, BLACKSMITH DRILLS.
BUFFALO FORGE CO.
BUFFALO, N.Y.



Cincinnati Centennial Exposition.

To the Committee on Rules, Jurors and Awards.

GENTLEMEN:

We, your committee appointed to make examination of Class 6, Group 41, have performed that duty, and find as follows:

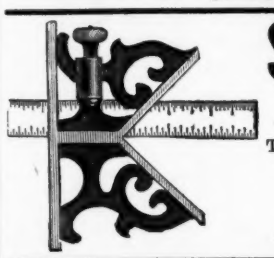
Engine Lathe; The G. A. Gray Co., Cincinnati, O. The points of excellence of this lathe over others exhibited are:

1st. Design and Proportions.
2d. Perfect contact on all plane surfaces.
3d. Change of feed.
4th. Taper and screw cutting attachments.
5th. Accuracy of workmanship and superior finish.

This lathe having shown in a number of different measurements, not only a superiority over all others examined, but a perfection seldom attained in machines of this class,

We award a Gold Medal.

D. D. MARTIN,
WM. CORRY,
M. L. ANDREWS, } *Jurors.*



STANDARD TOOL CO.,

ATHOL, MASS.,
MANUFACTURERS OF
The Celebrated Chaplin Try and Center Square, Standard Steel Rules, Steel Caliper Rules, Universal Bevels, Caliper Gauges, Improved Surface Gauges, Bevel Protractors, Depth Gauges, Screw Pitch and Center Gauges, Hardened Steel Squares, Graduated Steel Squares, Spring Calipers, Pliers, Straight Edges, &c., &c.
WRITE FOR ILLUSTRATED CATALOGUE AND PRICE LIST OF FULL LINE.

U. BAIRD MACHINERY CO.

Pittsburgh, Pa.

MACHINISTS' TOOLS AND SUPPLIES.
Pattern Makers' Tools. Boiler Makers' Tools.
STURTEVANT BLOWERS AND EXHAUST FANS.

WILLIAM BARKER & CO.,

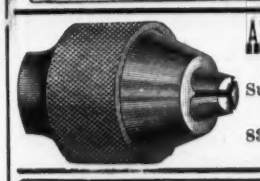
Manufacturers of
Iron and Brass Working
MACHINERY
Send for circulars and prices.
140 & 142 E. Sixth St., Near Culvert,
CINCINNATI, O.

DRILLING MACHINES.

ALL STYLES WITH
Latest Designs and Improvements.
For cuts and prices address,
BICKFORD DRILL CO.,
Front & Pike Sts., Cincinnati, O.

OUR NEW CATALOGUE OF TOOLS
And Supplies sent free to any address on receipt of Ten Cents in stamps (for postage.)
Chas. A. Strelinger & Co., WOOD AVE., Detroit, Mich.

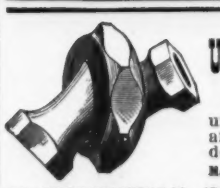
THE NATIONAL AUTOMATIC BOLT CUTTER
"THE BEST"
PREMIUM AT EVERY EXPOSITION
CATALOGUES ON APPLICATION
BOLT HEADERS POINTERS
RIVET, SPIKE HOT & COLD UPSETTERS
CARRIAGE BOLT MACHINERY
HOT & COLD AUTOMATIC NUT & WASHER TAPPERS OF EVERY STYLE
WIRE NAIL MACHINES
THE ONLY SPECIALISTS FURNISHING COMPLETE PLANTS IN THE U.S.
THE NATIONAL MACHINERY CO
TIFFIN, OHIO, U.S.



Almond Drill Chuck,

Sold at all Machinists' Supply Stores.
T. R. ALMOND,
83 & 85 Washington St.
BROOKLYN, N. Y.

PRESSES, DIES AND OTHER SHEET-METAL TOOLS
FERRACUTE MACHINE CO.
BRIDGETON, N. JERSEY, U.S.A.



HODGE'S
Universal Angle Union
PATENTED.
Combining an elbow and union, and can be set at any angle at which it is desired to run the pipe.
Manufacturers & Wholesale Agents,
ROLLSTONE MACHINE CO., 45 Water St., FITCHBURG, MASS.

WILLIAM SELLERS & CO., Incorporated.

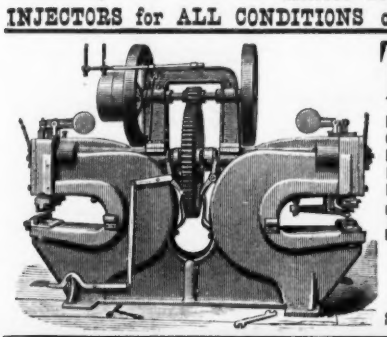
PHILADELPHIA, PA.

BUILDERS OF

MACHINE TOOLS FOR WORKING IRON AND STEEL,

Improved TURNTABLES for LOCOMOTIVES, CARS and PIVOT BRIDGES. High Speed Power Traveling Cranes and Hand or Power Swing Cranes, Shafting, Pulleys, Hangers, &c., for transmission of power. Improved Self-Adjusting Injector of 1876. Self-Acting Injector of 1887. Fixed-Nozzle Automatic Injector of 1885.

INJECTORS for ALL CONDITIONS of LOCOMOTIVE and STATIONARY SERVICE.



THE LONG & ALLSTATTER CO. Hamilton OHIO.

Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven

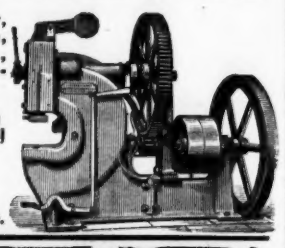
Punches and Shears,

OVER 300 SIZES.

ALSO

Power Cushioned Hammer.

Send for New Catalogue.



All GENUINE INGOTS & MANUFACTURES BEAR OUR REG. TRADE MARKS.

"Phosphor-Bronze."

PHOSPHOR-BRONZE

INGOTS, CASTINGS & MANUFACTURES.

THE PHOSPHOR BRONZE SMELTING CO. LIMITED

512 ARCH ST. PHILADELPHIA PA. U.S.A.

ORIGINAL MANUFACTURERS OF PHOSPHOR-BRONZE IN THE UNITED STATES AND OWNERS OF THE U.S. PATENTS.

THE BECKETT FOUNDRY & MACHINE CO.

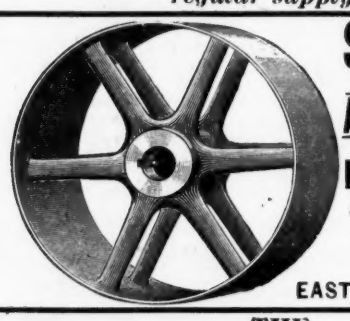
S. A. BECKETT, President. ARLINGTON, N. J. F. A. CHAPMAN, Sec. and Treas.

Successors to THE BECKETT & McDOWELL MFG. CO.

IRON FOUNDERS AND MACHINISTS

MANUFACTURERS OF STEAM ENGINES AND GENERAL MACHINERY. SPECIALTIES: ORE-CRUSHING MACHINERY, STAMP MILLS AND MINING HOISTS.

Having Extensive Foundry Capacity, we are prepared to contract for regular supply of Machinery Castings.



SHAFTING, HANGERS, AND PULLEYS A SPECIALTY.

FIRST-CLASS IN EVERY RESPECT.

Send Specifications for Estimates before Contracting.

THE LANE & BODLEY CO.

EAST SIDE JOHN, Corner WATER ST., CINCINNATI, O.

THE BROWNELL ANTI-FRICTION

Step or Thrust Bearing

FOR

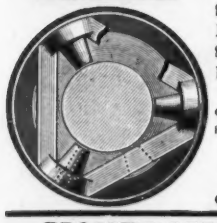
Lathes, Drills, Worm Shafts of Elevators or Hoists, Jack Screws, Mill Stones, Water Wheel and Propeller Shafts.

Bearings of all sizes made to order, and patent rights for sale by

G. L. BROWNELL,

WORCESTER, MASS.

Correspondence Solicited.



MONTGOMERY & CO.,

105 FULTON ST., NEW YORK,

TOOLS, SUPPLIES AND MACHINERY

FOR ALL BRANCHES OF THE MECHANICAL TRADES.

Illustrated Catalogue (300 pages) mailed on receipt of Fourteen Cents.

WELDLESS STEEL TUBES COLD DRAWN

QUICK OPENING GATE VALVE.

SMOOTH INSIDE & OUT.

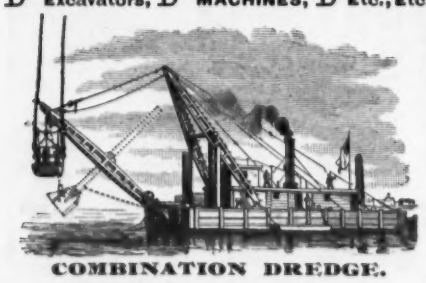
JOHN S. LENG, 4 Fletcher St. N.Y.

OSGOOD DREDGE CO., - ALBANY, N. Y.

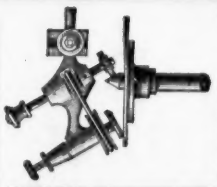
RALPH R. OSGOOD, Pres. JAMES H. BLESSING, Vice-Pres. JOHN K. HOWE, Secretary and Treasurer.

Manufacturers of

DREDGES, Excavators, DITCHING MACHINES, DERRICKS, Etc., Etc.



COMBINATION DREDGE.



ENERGY MFG. CO.,

1115 South 15th St.,

PHILA., PA.

Sole makers of Rope Hoisting Machines, Drill Guides, etc. Two sizes of Center Grinders, for small and large lathes. Will true up centers quicker than any other device. Send for descriptive circular of specialties.

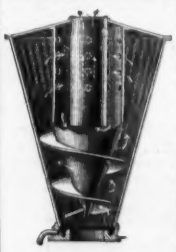
FINE TAPS AND DIES.

LIGHTNING AND GREEN RIVER SCREW PLATES,

Bolt Cutters, Hand and Power Drilling Machines, Punching Presses, Tire Benders, Tire Upsetters and Other Labor-Saving Tools. Send for Price List.

WILEY & RUSSELL MFG. CO., Greenfield, Mass.

SIMPSON'S CENTRIFUGAL EXHAUST HEAD.



Thoroughly entraps water and grease from the exhaust of a steam engine without back pressure, preventing them from spraying on the sidewalks and roofs of buildings; it protects the latter from injury, and passers by from annoyance and damage. Send for circular to

KEYSTONE ENGINE & MACHINE WKS.,

5th and Buttonwood Sts., Phila., Pa.,

Or ARTHUR APPLETON, Selling Agent, 45 Cortlandt Street, N. Y.

OPEN SIDE IRON PLANERS

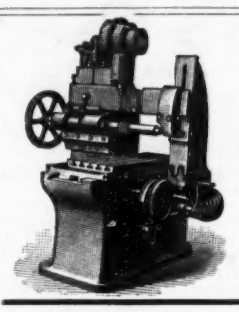
FOR QUICK DELIVERY.

1 30"x25"x 6 ft.	Size "C."
1 30"x25"x 8 ft.	Size "C."
1 30"x25"x10 ft.	Size "C."
1 36"x30"x 8 ft.	Size "D."
1 36"x30"x10 ft.	Size "D."
1 48"x36"x10 ft.	Size "E."
1 48"x36"x14 ft.	Size "E."
1 48"x48"x12 ft.	Size "E. 1."
1 48"x48"x14 ft.	Size "E. 1."

WRITE FOR PRICES, PHOTOTYPES, Etc.

Detrick & Harvey,

BALTIMORE, MD.



BEMENT, MILES & CO.,

PHILADELPHIA, PA.

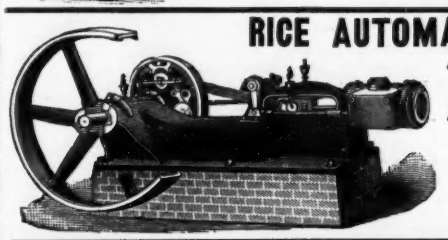
—BUILDERS OF—

METAL-WORKING MACHINE TOOLS

FOR

Railroad Shops, Locomotive and Car Builders, Machine Shops, Rolling Mills, Steam Forges, Ship Yards, Boiler Shops, Bridge Works, Etc., Etc.

RICE AUTOMATIC CUT-OFF ENGINE.



Self-Contained. Sensitive Governor. Balanced Valve. High Speed. Stationary Oilers. Best Economy.

Gold Medal Cincinnati Exposition, 1884.

THE JOHN T. NOYE MFG. CO.,

BUFFALO, N. Y.

ACME MACHINERY CO.

CLEVELAND, OHIO.

Manufacturers of "ACME"

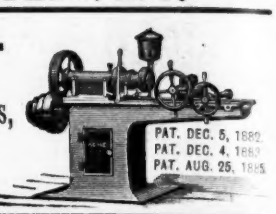
Single & Double Automatic Boltcutters,

Cutting from 3-8 in. to 6 in. diameter.

Also SEPARATE HEADS and DIES.

Send for Catalogues and Discounts.

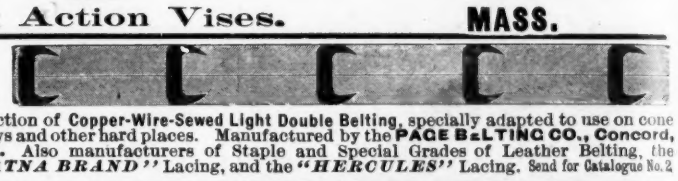
FIRST PREMIUM, CINCINNATI CENTENNIAL.



WYMAN & GORDON,

WORCESTER,

Quick Action Vises. MASS.



Section of Copper-Wire-Sewed Light Double Belting, specially adapted to use on cone pulleys and other hard places. Manufactured by the PAGE BELTING CO., Concord, N. H. Also manufacturers of Staple and Special Grades of Leather Belting, the *"PATNA BRAND"* Lacing, and the *"HERCULES"* Lacing. Send for Catalogue No. 2.

EAGLE ANVIL WORKS,

Trenton, N. J.

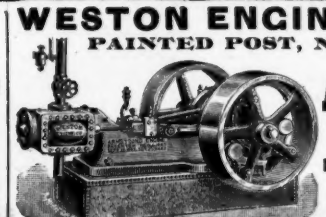
The Fisher Double Screw Leg Vise.—Warranted stronger grip than any other Vise. Always parallel and cannot be broken.

Send for Circulars.

The Eagle Anvil.—Best Cast Steel Face & Steel Horn. Better than any English anvil. Fully warranted and lower price.

WESTON ENGINE CO.

PAINTED POST, N. Y.



THE ARMSTRONG ENGINE.

CORRECT IN Design, Workmanship and Price.

5 to 75 H. P.

Gap Lathe, $125.

SHEPARD'S NEW $60 SCREW-CUTTING FOOT LATHE.

Foot and Power Lathes, Drill Presses, Scroll-saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, etc.

Lathes on trial. Lathes on payment. Send for catalogue of Outfits for Amateurs or Artisans.

Address H. L. SHEPARD, Agent, 134 E. Second St., Cincinnati, O.

WIRE STRAIGHTENER. Can be Used in any Hollow Spindle Lathe.

Automatic Wire Straightening and Cutting Machinery.

Manufactured by COLLINS-GIBBONS MFG. CO. 20 So. 2nd St., St. Louis, Mo.

Something New! One, two, three, and four spindle drills for light work.

DRILLS SENSITIVE

The most useful patented improvement in drill presses for years is applied.

Spindles driven with single, endless belts. Large driving pulleys, tightener and variable speeds provided.

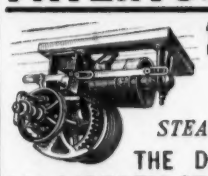
Over 1,000 in use Buy the **latest** and **best.** Special machinery to order. Catalogue of fine tools free.

Dwight Slate Machine Co.

HARTFORD, CONN.

PATENTS

THOMAS P. SIMPSON, Washington, D. C. No atty's fee until Patent obtained. Write for Inventor's Guide.



Friction Clutch Pulleys,

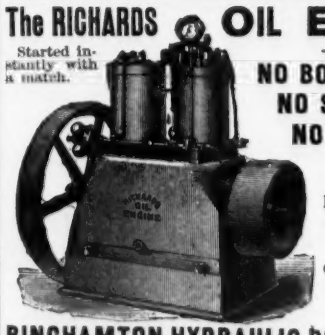
HOISTING ENGINES, ELEVATORS, STEAM AND BELT POWER.

THE D. FRISBIE COMPANY.

114 LIBERTY STREET, NEW YORK.

The RICHARDS OIL ENGINE.

Started instantly with a match.



NO BOILER. NO STEAM. NO DANGER.

Fuel, Crude Petroleum or Kerosene.

Cheaper than all others.

BINGHAMTON HYDRAULIC POWER CO.

BINGHAMTON, N. Y., U. S. A.,

SOLE MANUFACTURERS.

PECK'S PAT. DROP PRESS.

NEW HAVEN

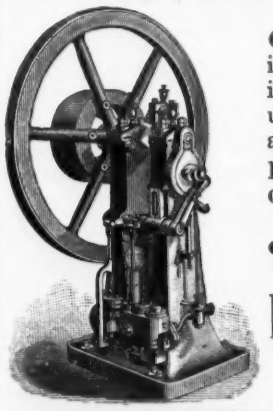
BEECHER & PECK, CONN.

DROP FORGINGS OF IRON OR STEEL

BEECHER & PECK, NEW HAVEN CONN.

KORTING GAS ENGINE.

1 to 100 Horse Power.



The Korting Gas Engine is placed upon its merits and under full guarantee to every purchaser.

OVER 125 IN USE IN N. Y. CITY.

CATALOGUES on APPLICATION.

KORTING GAS ENGINE CO.,

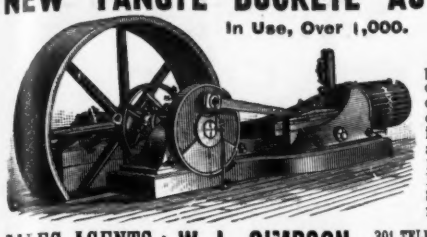
LIMITED.

429, 431 & 433 Greenwich Street.

Cor. Laight Street. NEW YORK CITY

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000. 25 to 1,000 H. P.



These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H.P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

SALES AGENTS: **W. L. SIMPSON,** 301 TELEPHONE BUILDING, 18 CORTLANDT STREET, N. Y. / N. W. ROBINSON, 154 Washington St., Chicago, Ill. / ROBINSON & CARY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.

THE ALBANY STEAM TRAP CO.'S

BUCKET AND GRAVITATING

TRAPS.

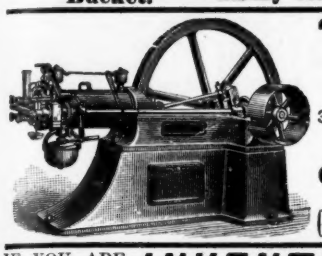
Bucket.

Automatically drain the water of condensation from **HEATING COILS** and return it to the boilers, whether the coils are **above or below** the water level in boiler, doing away with pumps and other mechanical devices for such purposes, Send also for Circulars of **Blessing's Renewable-Seat Stop and Check Valves, Pump Governors, and Water Circulator and Purifier.**

Gravitating

Albany Steam Trap Co. Albany N. Y.

"OTTO" GAS ENGINE WORKS.



SCHLEICHER, SCHUMM & CO.,

33d and Walnut Sts., PHILADELPHIA.

Branch Office, 130 Washington St., CHICAGO.

OVER 25,000 ENGINES IN USE.

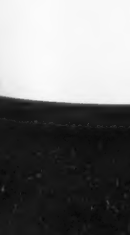
GUARANTEED To Consume 25 to 75 Per Cent. Less Gas than ANY Other Gas Engine doing the same work.

IF YOU ARE INTERESTED IN **INVENTIONS**

And Care for Facts About

PATENTS, Send for PAMPHLET No. 2, for MECHANICS AND INVENTORS.

J. B. CHAMBERLAIN, 500 Fifth St., Washington, D. C.

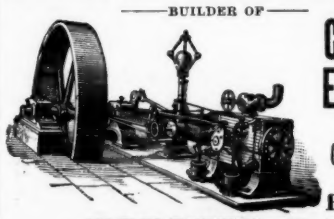


WANTED TOOL AGENTS in Shops South and West of Penna. Send 10c. for Postage on Free Outfit.

C. B. JAMES, 98 Lake St., Chicago. (Successor to E. H. RANDALL & CO.)

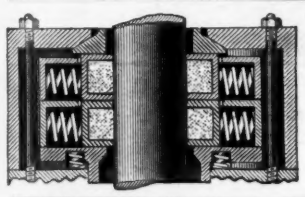
JOHN McLAREN,

BUILDER OF



CORLISS Engines, AIR Compressors and BOILERS.

HOBOKEN, N. J.



ANDREW GRAY, Pres. W. H. Hollis, Treas. E. P. MONROE, Gen'l Manager.

U. S. METALLIC PACKING CO.,

Philadelphia, Pa.

OFFICE, 133 S. 4th St. WORKS, 435 N. Broad St.

20,000 Packings in use on Locomotives, Stationary and Marine Engines.

TOOLS FOR MECHANICS

Chucks, Drills, Reamers, Screw-Plates, &c.

RAILROAD SUPPLIES.

✦ NEW CATALOGUE NOW READY. ✦

PALMER, CUNNINGHAM & CO., L'd.

607 MARKET ST., PHILADELPHIA, PA.

FOR SALE CHEAP

Fly Wheel Pulley 18ft. Dia., 46" Face, 11" Bore, made in 8 Segments. Weight 32,000 lbs. In First Class Condition.

Webster, Camp & Lane Machine Co.,

AKRON, OHIO.

MACHINERY ON HAND.

16 in. x 42 in.	Planer,	Bridgeport,	new.
22 in. x 4-5 and 6 ft.	"	Powell,	"
24 in. x 6 ft.	"	Powell,	"
30 in. x 8 ft.	"	each Atherton, Powell & H. & P.	new.
36 in. x 12 ft.	"	Niles,	A 1.
12 in. x 5 1-2 ft.	Engine Lathe,	S. M. & Co.	new.
12 in. x 6 ft.	"	Young,	"
13 in. x 6 ft.	"	Ames,	"
14 in. x 6 ft.	"	Blaisdell,	"
14 in. x 7 ft.	"	Bogart,	"
14 in. x 6 ft	"	Gap Bed, S. M. & Co.,	"
15 in. x 6 and 8 ft.	"	Porter,	"
16 in. x 6 and 8 ft.	"	Blaisdell,	"
16-20 in. x 6-8-10 & 12 ft.		Bridgeport,	"
18 in. x 8-10-12 ft.	"	Different Makes,	"
20 in. x 8-10-14 ft.	"	Different Makes,	"
20 in. any length Bed	"	Bridgeport,	"
22 in. x 12 ft.	"	Niles,	heavy, good.
22 in. x 8-10-12 & 14 1-2	"	Br dgeport,	new.
26 in. x 12 ft.	"	Wright,	"
24 in. x 14 & 20 ft.	"	Ames,	"
28 in. x 14-16 & 18ft.	Engine Lathes,	T. & S.	"
20 in.	Drill	Davis,	"
20-23-25-28 inch	Drills	Blaisdell,	"
20-25-28-32 inch	"	C. & S.	"
5 ft.	Arm Universal Radial Drill,		"
Cabinet Turret Lathe,	Lodge, Davis & Co.		"
No. 5 Screw Machine,	Jones, Lamson & Co.		"
No. 2 4 "	"	Brown & Sharpe.	"
No. 3 Garvin Hand Miller,			A 1.
No. 5 Brainard	"		A 1.
Lincoln Pattern,	"		good order.
No. 1 and 3 Universal Miller,	Brown & Sharpe,		new.
No. 1-2 and 5 Plain "	"	"	"
No. 1 Universal Grinder,	"	"	"
No. 3 Surface Grinder,			A 1.

Cold Rolled Shafting in Stock. Send for list. Write for what is wanted.

E. P. BULLARD,

62 COLLEGE PLACE & 72 WARREN ST., NEW YORK.

ATTENTION NEW ENGLAND BUYERS.

We have opened at 23 and 25 Purchase St., Boston, a depot for the exhibition and sale of our Improved Engine Lathes, Shapers, Drill Presses and Brass Working Machine Tools, &c. We make a feature of **Complete Engine Lathes,** without charge for extra attachments.

Call and examine them. Cuts, with full descriptions, free.

LODGE, DAVIS & CO.

23 & 25 Purchase St.,

BOSTON.

WORKS, Cincinnati, Ohio.

See Advertisement, Page 16.

THE WATTS, CAMPBELL CO.

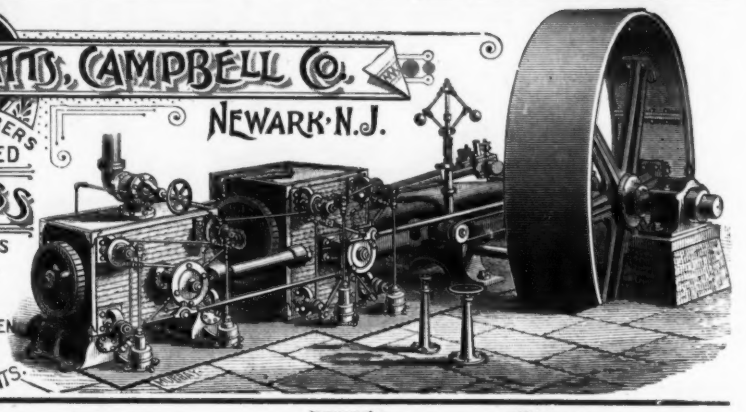
NEWARK, N.J.

MANUFACTURERS OF IMPROVED

CORLISS

STEAM ENGINES IN FULL VARIETY.

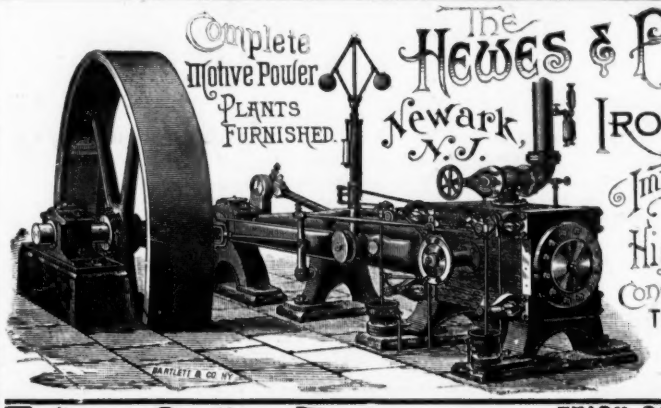
CONTRACTS TAKEN FOR COMPLETE POWER PLANTS.



The HEWES & PHILLIPS IRON WORKS

Newark, N.J.

Complete Motive Power Plants Furnished.



Improved CORLISS ENGINES. High Pressure, Condensing and Compound TUBULAR BOILERS

Eclipse Corliss Engine.

FRICK COMPANY, Builders, WAYNESBORO, PA.

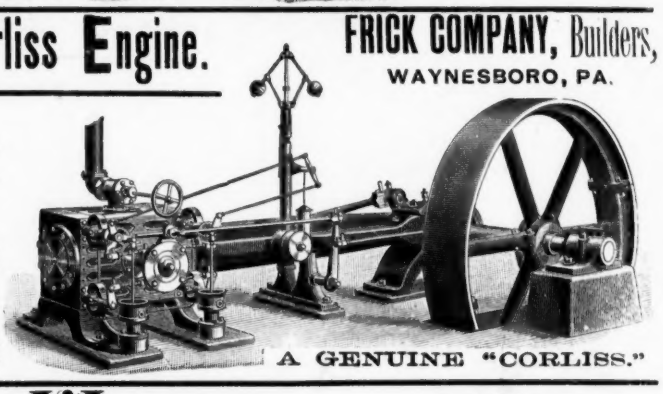
NON-CONDENSING, CONDENSING COMPOUND.

40 TO 1,000 H.P.

Send for Circulars.

E. P. HAMPSON & CO., 36 CORTLANDT ST., NEW YORK, Sole Eastern Agents.

JOHN J. METZGER, 69 S. Clinton St., Chicago, WESTERN AGENT.



A GENUINE "CORLISS."

ROBERT WHITEHILL,

NEWBURGH, N.Y.

MANUFACTURER OF IMPROVED

CORLISS ENGINES

ALSO

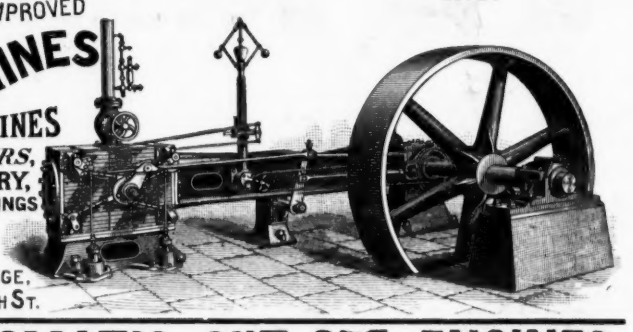
SLIDE VALVE ENGINES

STATIONARY BOILERS,

GENERAL MACHINERY,

IRON AND BRASS CASTINGS

NEW YORK OFFICE Room 6, COAL AND IRON EXCHANGE, COR. CORTLANDT & CHURCH ST.



BALL AUTOMATIC CUT-OFF ENGINES,

ERIE, PA.

The characteristics of these Engines are Beauty of Design, Superior Finish, Limited Feet in Space required, Economy of Fuel, Perfection of Regulation.

CHARLES R. VINCENT & CO.,

NEW YORK SELLING OFFICE, 15 CORTLANDT STREET.

STEARNS M'F'G CO.

ERIE, PA.

ENGINES from 15 to 400 Horse Power

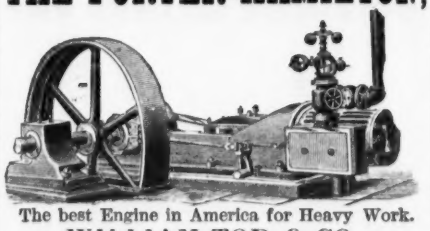
Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogue.

SAW MILLS and GENERAL MACHINERY

NEW YORK STORE, 46 Cortlandt St.

BORING AND TURNING MILLS. LATHES PLANERS DRILL PRESSES F. P. MICHEL ROCHESTER N.Y.

THE PORTER-HAMILTON,



The best Engine in America for Heavy Work.

WILLIAM TOD & CO.,

Youngstown, Ohio.

HILL, CLARKE & CO.

List of Second-Hand

MACHINERY.

15" x 6' Engine Lathe,	Lathe & Morse.
16" x 6' Engine Lathe.	Powell.
16" x 6' Engine Lathe,	Blaisdell.
16" x 6' Engine Lathe Taper,	Reed.
18" x 6' Engine Lathe,	Blaisdell.
20" x 8' Engine Lathe,	Powell.
21" x 10' Engine Lathe,	Lathe & Morse, (new).
27" x 16' Engine Lathe,	Lathe & Morse, (new).
37" x 14' Engine Lathe,	Gleason, (new).
Cabinet Turret Lathe,	Lodge, Davis & Co. (new).
16" x 16" x 3' Planer,	Lathe & Morse.
22" x 22" x 5' Planer,	Hendey.
26" x 26" x 6' Planer,	Hendey.
30" x 30" x 8' Planer,	Bement.
36" x 36" x 10' Planer,	Whitcomb, (new).
15" Stroke Shaper,	Hendey.
Crank Planer,	Lathe & Morse.
20" Upright Drill,	Prentice.
22" Upright Drill,	Reed.
28" Upright Drill,	Bickford.

Above 2d-hand tools are in first-class condition. Write for prices and descriptions.

156 OLIVER STREET,

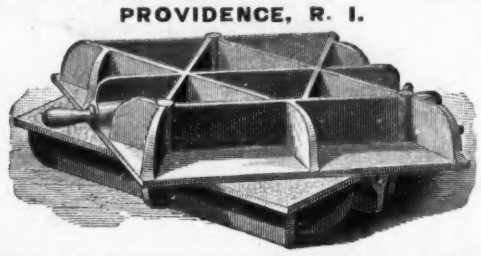
BOSTON, MASS.

BROWN & SHARPE MFG. CO.,

MANUFACTURERS OF

MACHINERY AND TOOLS

PROVIDENCE, R. I.



SIZES OF SURFACE PLATES IN STOCK.

3½ × 12″	weight,	11 lbs.	9 × 9″	weight,	16 lbs.	18 × 18″	weight,	65 lbs.
4½ × 6″	"	5 "	9 × 14″	"	27 "	18 × 24″	"	128 "
6 × 6″	"	7 "	10 × 15″	"	35 "	18 × 36″	"	228 "
6 × 12″	"	19 "	10 × 30″	"	99 "	20 × 78″	"	813 "
6 × 50″	"	120 "	12 × 12″	"	29 "	24 × 24″	"	164 "
6½ × 18″	"	30 "	12 × 18″	"	53 "	24 × 36″	"	298 "
7 × 7½″	"	11 "	14 × 14″	"	47 "	24 × 48″	"	442 "
7 × 10″	"	15 "	14 × 18″	"	62 "	24 × 60″	"	666 "
8 × 12″	"	21 "	16 × 16″	"	62 "	36 × 68″	"	1024 "

OTHER SIZES MADE TO ORDER.

Illustrated Catalogue Mailed on Application.

WESTERN AGENT, S. A. SMITH, 23 South Canal Street, Chicago, Ill.

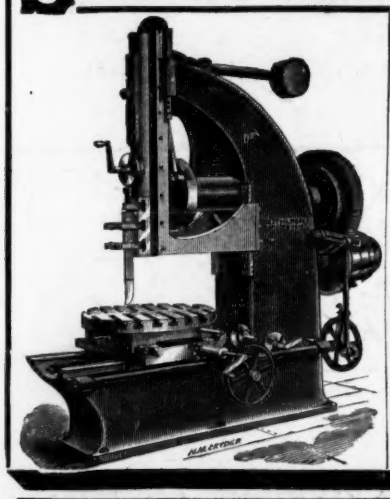
THE PRATT & WHITNEY CO.,

HARTFORD, CONN.,

Manufacture Gardner & Woodbridge patent and new Threading Tool, Rhodes' Square Thread Tool, Woodbridge Lathe and Planer Tool, Johnson's Cutting-off Tool, Kidd's Improved Dividers and Adjustable Caliper Gauges.

WESTERN BRANCH, 100 West Washington Street, Chicago, Ills.

SLOTTING MACHINES



9 to 48 in. Stroke. New Patterns.

RAM GUIDE

ADJUSTABLE VERTICALLY.

Feed always takes place at upper end of stroke —never during cut.

VERY HEAVY AND POWERFUL.

NILES TOOL WORKS

Hamilton, Ohio.

NEW YORK, - - 96 Liberty St.
PHILADELPHIA, - - 705 Arch St.
CHICAGO, - - 96 Lake St

THE BILLINGS & SPENCER CO. HARTFORD CONN.
MANUFACTURERS OF
STANDARD MACHINE WRENCHES
DROP FORGED OF
BAR STEEL
IN 16 SIZES.
TAKING NUTS FOR ¼ INCH UP TO AND INCLUDING NUTS FOR 1¾ INCH BOLTS.

WARNER & SWASEY,

CLEVELAND, OHIO,

MACHINE TOOLS

For Iron and Brass Work.

SMALL TOOLS & FIXTURES.

Gear Cutting in all its Branches.

ILLUSTRATED CATALOGUE ON APPLICATION.

REMOVAL.

THE POND MACHINE TOOL COMPANY,

Formerly of Worcester, Mass.

The new shops of this company are located at Plainfield, N. J., forty minutes' ride from New York city on the line of the Central Railroad of N. J., and consist of the following:

A machine shop 500′ long by 100′ wide; a foundry 250′ long by 90′ wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fireproof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.

SALESROOM and OFFICE, 111 & 113 Liberty St., N. Y. City.
NEW SHOPS, Plainfield, N. J.

CRANES

THE YALE & TOWNE MFG CO.
STAMFORD CONN
NEW YORK CHICAGO PHILA BOSTON

The Original Unvulcanized Packing

CALLED THE STANDARD—As it is the Packing by which all others are compared.

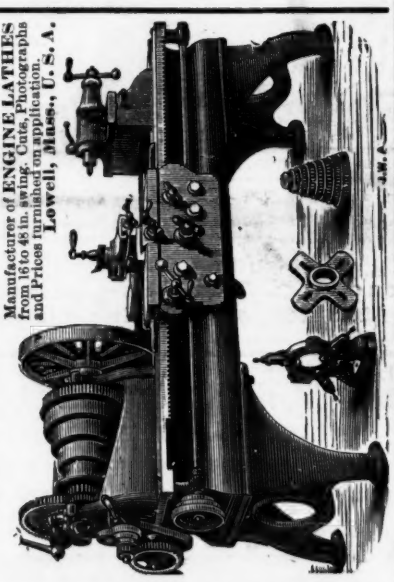
Accept no packing as JENKINS PACKING unless stamped with our "Trade Mark."

JENKINS BROS. { 71 JOHN STREET, N. Y. / 105 MILK STREET, BOSTON. / 21 NORTH FIFTH ST., PHILA. / 54 DEARBORN STREET, CHICAGO.

GEO. W. FIFIELD,

Manufacturer of ENGINE LATHES from 16 to 48 in. swing. Cuts, Photographs and Prices furnished on application.

Lowell, Mass., U. S. A.

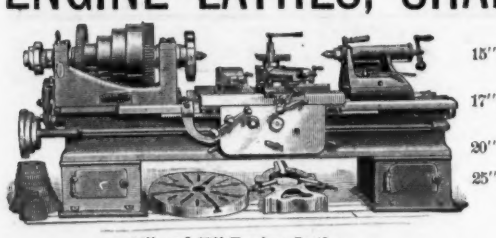


Gear Wheels and Gear Cutting.—I make g to order, or cut teeth on g blanks sent to me. Of all kinds. Of all sizes to six ft. dm. Small orders or large ones. Fine g or cheap g. Small cast g. Ready made brass g by mail at low prices. Bevel g with perfect planed teeth. Hand Book on g, $1. Facilities complete. Terms reasonable. Send for cat. GEO. B. GRANT, 66 Beverly St., Boston, Mass.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

J. M. ALLEN, PRESIDENT.
W. B. FRANKLIN, VICE-PRESIDENT
J. B. PIERCE, SECRETARY.

ENGINE LATHES, SHAPERS & DRILLS.



24″ and 27″ Engine Lathe.

15″ 20″ 26″ 32″ Shapers.

17″ 19″ 21″ 24″ 27″ and 38″ Engine Lathes.

20″ 24″ Upright Drills.

25″ 28″ 32″ 40″ B. G. P. F. Drills.

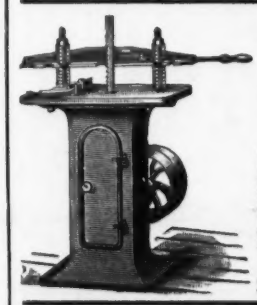
25-INCH BACK GEARED AND POWER FEED DRILL.

LODGE, DAVIS & CO.,

CINCINNATI, OHIO.

SEND FOR PRICES. IT WILL PAY YOU.

See advertisement, page 15.



KEY-SEATING MACHINES, and 20-in. Drills

A SPECIALTY.

Our Key-Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment both Key-Seating Machines and 20-in. Drills. Send for Photo. and Catalogue.

W. P. DAVIS,
NORTH BLOOMFIELD, N. Y.

PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND

J. WYKE & CO., TWIST DRILL GAUGE.

Fine Machinists' Tools.—E. Boston, Mass—Send for Circular.

NEW CATALOGUE

MACHINE TOOLS.

THE G. A. GRAY CO.,

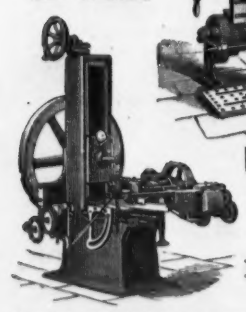
477-481 SYCAMORE ST., CINCINNATI, O.

See advertisement, page 13.

GOULD & EBERHARDT,

Near Market St. Depot,
NEWARK, N. J.

Pat. Shapers.
NEARLY 1,500 IN USE.



EBERHARDT'S Patent GEAR CUTTER.

In Use throughout the World.

GEAR AND RACK CUTTING TO ORDER.

HEADQUARTERS IN NEW YORK CITY FOR

STANDARD

Milling Machines,

UNIVERSAL OR PLAIN FOR LIGHT HEAVY WORK.

All sizes ready for quick delivery.

Machines shown in operation by the man'f'rs,

E. E. GARVIN & CO.,

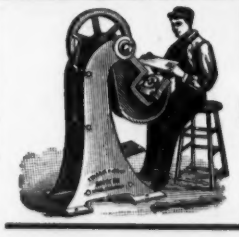
139-141-143 CENTRE STREET,

Send for Illustrated Catalogue. NEW YORK CITY.

STEEL CASTINGS.

PRATT & LETCHWORTH, PROPRIETORS

Buffalo Steel Foundry, BUFFALO, N. Y.



PUNCHING PRESSES, DIES,

And other Tools for the Manufacture of all kinds of

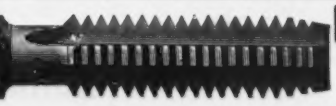
SHEET METAL GOODS, DROP FORGINGS, ETC, DROP HAMMERS.

STILES & PARKER PRESS CO.

MIDDLETOWN, CONN.

Branch Office and Factory 203, 205 and 207 CENTRE STREET, NEW YORK.

J. M. CARPENTER
PAWTUCKET, R. I.



Manufacturer —of— TAPS & DIES